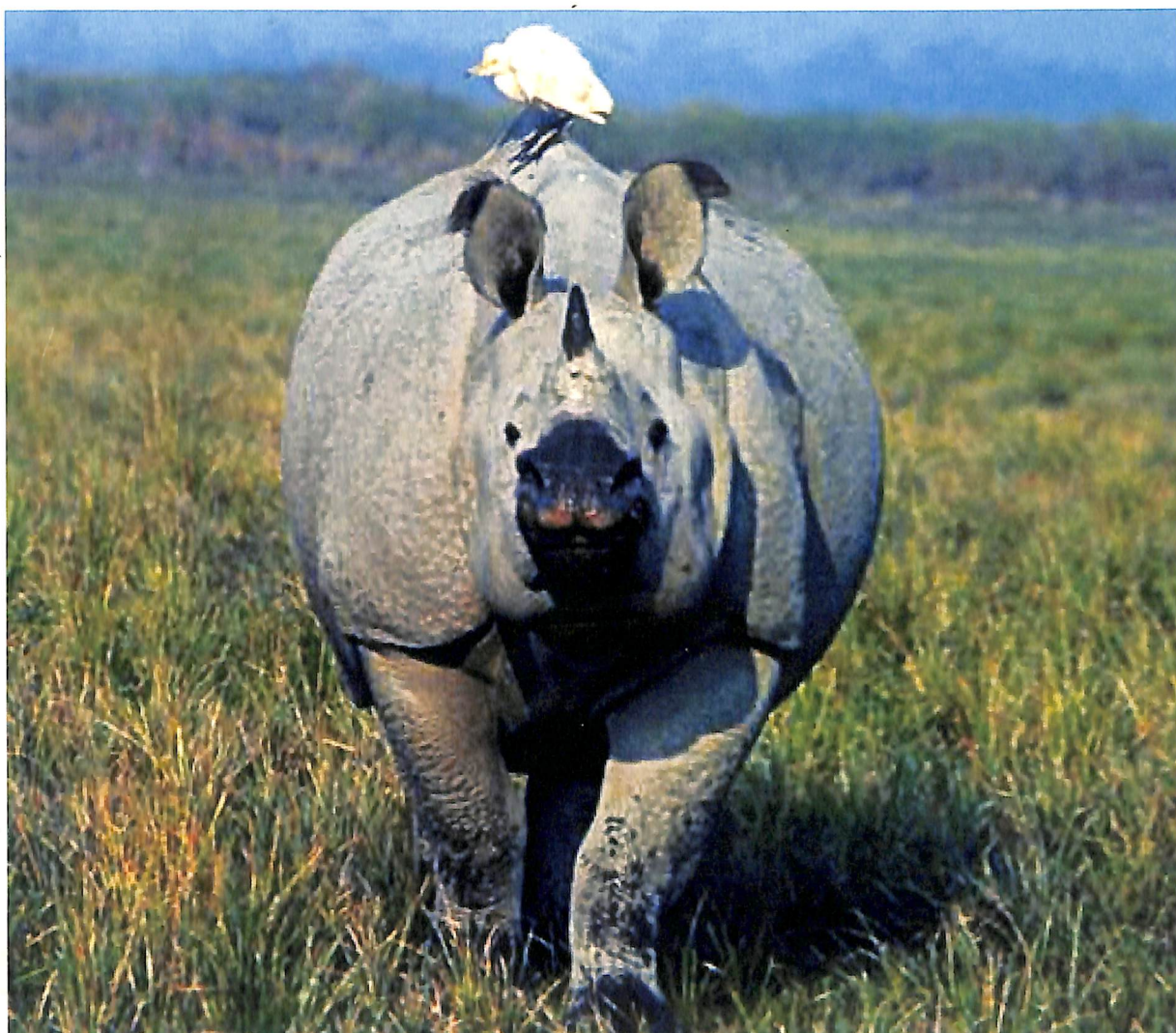


THE GREAT INDIAN ONE-HORNED RHINOCEROS (*RHINOCEROS UNICORNIS*) IN INDIA AND NEPAL

A REVIEW

by

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and
Bitapi C Sinha



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CONTENTS

Introduction	1
Historical Records on the Great Indian One-Horned Rhinoceros in North India and neighbouring countries	5
Morphological Features of the great Indian One-horned Rhinoceros	10
Indian Rhinoceros in religion, mythology, beliefs and rituals	14
Legal Status	17
Why the Need for Rhino Re-Introduction?	18
Captive Elephant Management for Indian Rhino at Dudwa	27
Need for enlarging the great Indian One-horned rhino habitat, and trans-location of Rhinos in Bhadhital area in Dudhwa National Park	32
The future of the Great Indian One-horned Rhinoceros	36
Bibliography	38

Chapter I

INTRODUCTION

The Great Indian One-horned Rhinoceros (*Rhinoceros unicornis*) is listed as one of the world's most endangered species among the mega herbivores (IUCN, 1990). Within the Indian subcontinent, it once ranged from the foothills of the Hindukush mountain range (Pakistan) to Myanmar, all along the flood plain of rivers Indus, Ganges and Brahmaputra (Laurie, 1978). In the relics of the Mohenjo-Daro era, some Indian Rhino seals were found which have been preserved in the Indian National Museum, New Delhi. Out of the three species of Indian Rhino that roamed over the Indo-Gangetic and Brahmaputra floodplains, two species, namely, Javan Rhinoceros (*Rhinoceros sondaicus*) which was once "fairly common" in the Sundarbans became extinct in India about 1900, and the Sumatran Rhino (*Didermoceus sumatrensis*) disappeared from the Lushai hills of Assam in 1935. The only species of Asiatic Rhinoceros that now exists in the Indian subcontinent, is the Great Indian One-Horned Rhinoceros (*Rhinoceros unicornis*).

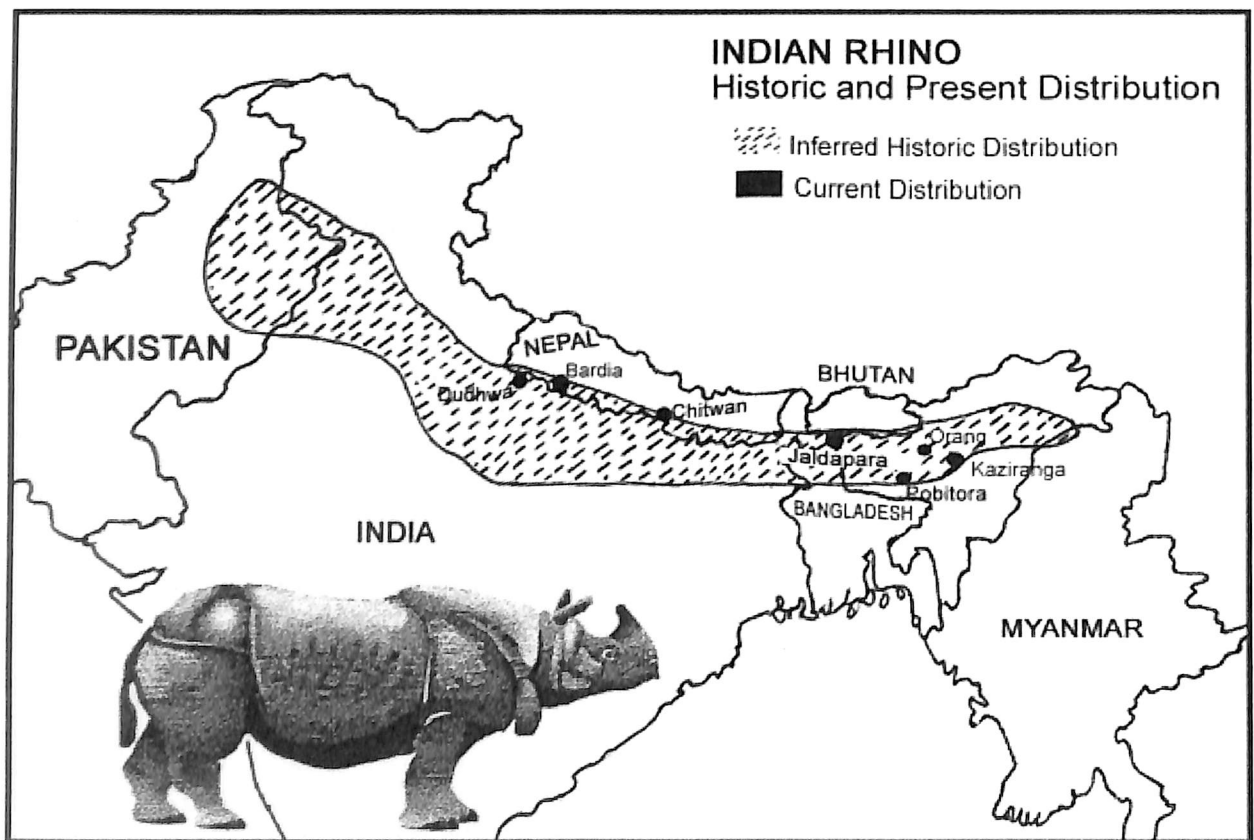
The causes for the disappearance of the Great Indian One-Horned Rhinoceros, henceforth called Indian Rhino, from several locations of its former range of distribution and decline of population were primarily the following:

- * Destruction and fragmentation of the Indian Rhino habitat, primarily for extension of agriculture.
- * Hunting of the Indian Rhino for sport during the Moghul period, and in the early days of British Rule in India.
- * Poaching of the Indian Rhino for horns and other parts attributed to have magical medicinal values.

It is interesting to note that in Assam, Col. Pollock, a Military Engineer, engaged in the laying of roads in the Brahmaputra Valley, shot a Indian Rhino or a Wild Buffalo before breakfast every day. A sportsman in Bengal Dooars, possibly an English Planter, fired about 100 shots at a number of Indian Rhinos in a day, killing five and seriously wounding more than twenty-five. Maharaja Nirpendra Narayan of Coochbehar shot 208 Rhinoceros from 1871 to 1907 (Anon, 1908).

The Indian Rhino also would undoubtedly have ceased to exist, but for the strict protection given to it, when its population fell to a very low level at the beginning of this century. Even though there is no precise documentation regarding the population of Indian Rhino that existed in India at the turn of the 19th century, its population was believed to be around 100 at the beginning of the 20th century, estimated at roughly 50 to 60 in Assam and 40-50 in West Bengal. At present, Indian Rhino has a total wild population of around 2674 animals in the world, that too only in India and Nepal. In India, currently its population is restricted to four natural populations in Assam, viz, Kaziranga, Manas, Orang (Rajiv Gandhi WLS) and Pobitora, two natural populations in West Bengal, viz, Jaldapara and Gorumara, and one re-introduced population in the Dudhwa National Park and one migratory population in the Katarniaghat Wildlife Sanctuary in Uttar Pradesh. There are a few Indian Rhino existing in Bhutan, adjacent to Manas Tiger Reserve, Assam. They may have moved from the Manas Tiger Reserve.

In Nepal, the Chitwan valley harboured about 1,000 rhinoceros until 1950s (Gurung, 1989). Indiscriminate poaching and destruction of habitat in the mid 1950s and 1960s drastically reduced the Indian



The Indian Rhino has been eliminated from more than 95% of its former range,
and now survive in few pockets

Rhino population to about 100 animals (Caughly, 1969, Penlinck and Upreti, 1972). With the creation of a National Park in 1973 and adequate protection the Indian Rhino population in the Royal Chitwan NP has now recovered to less than 400 individuals (Dinerstein and Price, 1991; Khan and Foose, 1994). The density of rhinos in the prime area of Chitwan is estimated to be 8-10 animals/sq. km (Dinerstein and Price, 1991).

In Nepal, the three Indian Rhino populations are in Royal Chitwan NP, Royal Bardia NP and Sukhlaphanta WLS. The population of Royal Chitwan NP is a natural Indian Rhino population while Royal Bardia NP and Sukhlaphanta WLS have a re-introduced population. The Kaziranga National Park in Assam (India) has the highest population of Indian Rhino (about 2006) and the Pobitora WLS (85 rhinos in 16 sq km area) followed by Royal Chitwan NP in Nepal (less than 400 rhinos). There is no precise documentation regarding the population of Indian Rhino that existed in India at the turn of the century, its population was believed to be around 100 in the beginning of the current century being roughly 50 to 60 in Assam and 40 to 50 in Bengal.

The population in West Bengal rose to about 90 around the mid 1960s and in Assam to about 1500 by 1999. Extensive poaching of the Indian Rhino took place in West Bengal during the period 1968 to 1972, when 32 Rhinoceros were poached. In 1986, the Indian Rhino population in West Bengal came down to 22. Heavy poaching of Indian Rhino in Assam took place from 1989 to 1993 when a total of 275 Rhinos were killed by poachers and in the ten years from 1989 to 1998, 299 rhinos were killed by poachers in Kaziranga National Park alone. Currently, in Assam the scenario has changed due to strict protective measures and Indian Rhino poaching is on the decline. Statistics reveal that the poaching trend in Assam declined between 2001 and 2004, and then increased marginally in 2005. In the past ten years (1996-2005), 156 rhinos were poached in the Kaziranga National Park, Orang

National Park and the Pobitora Wildlife Sanctuary, the three major Indian Rhino habitats of the State. The last census of 2006, estimated 2,006 rhinos in Assam confined to the three protected areas. This includes three relocated rhinos in the Manas National Park, where the Rhino population was exterminated during prolonged social unrest in the 1990s. The Laokhowa sanctuary, too, suffered a similar fate in the 1980s when its entire Rhino population was wiped out.

While the number of rhinos in Kaziranga and Pobitora has been increasing steadily over the years, even more heartening is the recent trend in the Orang National Park. Orang, which has an area of 78.8 sq km, had witnessed heavy poaching during 1995-2000, with an average of ten rhinos killed every year, resulting in a fall in Rhino numbers from 97 in 1993, to only 46 in 1999. But since then, the Park has emerged strong with no reports of Rhino poaching in the past 14 months (April 2005 to May 2006), after losing three rhinos in March 2005, Orang has learnt from its past mistakes and identified the gaps in protection, resulting in efficient Rhino protection in the past four or five years. Between 2000 and 2005, Orang lost 24 rhinos; 11 died of natural causes while 13 were poached. Significantly, no rhinos were poached in 2002 or 2004. In 2005, three were poached in the month of March by well-organized poachers. From a mere 46 rhinos counted in 1999, the Rhino population in Orang now stands at 68, according to the March 2006 census conducted by the Assam Forest Department.

In Pobitora, the Indian Rhino population increased from a low of 54 in 1987 to 81 in 2006. Firearms and electrocution are the two major methods used by poachers in Pobitora. There has been one instance where two rhinos, a mother and a calf, were killed by chemical poisoning in 1987. Between 2000 and 2005, eight rhinos were poached in Pobitora, five by gunshot and three by electrocution. In Pobitora, poachers take advantage of the domestic electricity line passing along and within the sanctuary, to kill rhinos.



Pic: Ashish Chandola

Under strict protection, the Indian Rhino can thrive such as in Kazirange (above),
Pabitora, Orang, Jaldapara

Table 1: Indian Rhino Population in India and Nepal (2007)

Country	State	PA	Estimated Population
India	Assam	Kaziranga NP	2000
		Manas WLS	2
		Orang WLS	68
		Pobitora WLS	81
	West Bengal	Jaldapara WLS	65
		Gorumara NP	25
	Uttar Pradesh	Dudhwa NP	23
		Katerniaghat WLS	6
Nepal		Royal Bardia NP	26 (-6)*
		Royal Chitwan NP	372
		Sukhlaphanta WLR	6
Total Number of Rhinos in India and Nepal			2674

Source: Official census figures from the Forest Department for different Rhino Areas

* Six rhinos moved from Bardia NP, Nepal to Katerniaghat WLS, India

Chapter II

HISTORICAL RECORDS ON THE GREAT INDIAN ONE-HORNED RHINOCEROS IN NORTH INDIA AND NEIGHBOURING COUNTRIES

The Greater One-horned Rhinoceros (*Rhinoceros unicornis*) is an endangered species of Indian mega fauna and one of the five remaining species of rhinoceros of an approximately 30 genera that once roamed the world (Nowak and Paradiso, 1983). Rhinoceroses first appeared in the late Eocene period. The oldest Indian rhinoceros like species was *Brontops robustus*, but the genus *Rhinoceros* may be traced back to the Pliocene period in northern India, and fossilized remains show that these animals were dwellers of riversides and marshes. In India, the rhinoceros has an old and tradition-linked history. The representation of the rhinoceros iconographically, or its mention in written accounts has been reviewed by a number of authors including Yule and Burnell (1903), Ali (1927), Ettinghausen (1950), Rao (1957) and Rookmaaker (1982). Although most of these quote sixteenth and seventeenth century accounts by medieval authors and other second hand information, the accounts by Al Beruni and Ibn Batuta, two historians and scholars of the same period, are among the more authentic in detail. Akbar, the third Moghul emperor of India (1542-1605), records the existence of rhinoceros near Sambhal in Uttar Pradesh (Jarrat, 1949). Another Moghul emperor, Jahangir, records them in his memoirs as inhabiting Aligarh in Uttar Pradesh. A large number of miniature paintings and other objects depicting rhinoceros were made in India between 1500 and 1650 and there exists a famous miniature painting of circa 1600, showing the Emperor Jahangir hunting rhinoceros. Although the animals are easily recognizable as Greater One-horned Rhinoceros, all three kinds of Asian rhinoceros once inhabited the Indian subcontinent. The Javan Rhinoceros (*Rhinoceros sondaicus*) and Sumatran Rhinoceros (*Diceros sumatrensis*) became extinct in India in the early part of this century, and the Greater One-horned Rhinoceros is therefore now

the only rhinoceros species left in the wild in India. Rookmaaker (2002) reported that there are very few reports of Indian Rhinoceros from the northern states of India. The Indian Rhinoceros lived along the River Ganges from Delhi in the west until 1650, to Mirzapur, Patna and Rajmahal in the east until 1850. The animal also existed in the foothills of the Himalayas, just south of the Nepal border, and incidentally, stragglers from Nepal are still sighted there. The Rhinoceros was noted in the hills of Uttar Pradesh, at Pilibhit up to the 1870s; Baldwin (1877) mentioned the presence of rhinoceros in the Pilibhit district. According to Hewett (1938) the last rhinoceros was shot near the boundary of Pilibhit district by R. Drummond in the early 1870s (Martin & Martin, 1980). Several sources refer to the presence of rhinoceros in Rohilkhand, all following Jerdon (1874) who had heard reports from unidentified sportsmen (Blandford, 1891; Mukherji, 1963). Although Pilibhit was a part of Rohilkhand, the latter applies to a much wider region in northern Uttar Pradesh. Further to the east along the Nepal terai, on the Indian side of the border, two reserves are inhabited by the Indian rhinoceros.

In Kotdwar near Haridwar, the artist William Daniel and his companion arrived (he called it 'Coaduwar Gaut'), about 45 km east of the town of Haridwar, on 18 April 1789 (Archer, 1980). Two days later, the party unexpectedly met with a fine male rhinoceros, standing on the opposite side of a small stream. Long after their return to England, William Daniel published a series of seven volumes entitled 'The Oriental Annual; or Scenes in India' (1834-1840), with engravings originating from the Daniels' journey in India, and text written by Rev. Hobart Caunter. In the second volume dated 1835, the encounter with the 'Kotdwara Rhinoceros' is vividly remembered:

"The elephant is found in the lower regions of the mountains, and so is the rhinoceros, though less frequently. Of the latter animal we were fortunate enough to obtain a view, which is by no means a usual thing, as rarely met with. We had turned the angle of hill that abutted upon a narrow stream, when on the opposite side of the rivulet, we saw a fine male rhinoceros; it was standing near the edge of the water with its head slightly bent, as if it had been just slaking its thirst in the cooling stream. It stood, apparently with great composure, about two hundred yards above us, in an open vista of the wood. Mr. Daniel, under the protection of a lofty intervening bank, was able to approach sufficiently near it to make a perfect sketch of it; after which, upon a gun being fired, it deliberately walked off into the jungle. It did not appear in the least intimidated at the sight of our party, which remind at some distance, not all excited by the discharge of the gun" (Daniel & Caunter, 1835).

This is the only definite record of a rhinoceros anywhere in northern Uttar Pradesh, west of Nepal. Two drawings and an engraving of this animal are now known to exist (Rookmaaker, 1999 a & b).

Cockburn (1883) found at least two rock paintings or petroglyphs of rhinoceros in caves in the southern Mirzapur District. A poor representation was in a shelter in a village Roun in Pergunnah Burhur", a much better one in "Ghormangur cave". Both the shelter and the cave were in the vicinity of the fortress of Bidjeygurh or Bijagarh (UP), on the Son River (South of the Ganges). The age of the paintings is unknown, but they were of the seventeenth and eighteenth century. When the Moghul Emperor Zahiruddin Mohammed Babur (1483-1503) was near Chunar in 1529, he heard a man say, that in an island close to the edge of the camp, he had seen a lion and a rhinoceros. Next morning they drew a ring round the ground; also brought elephants in readiness, but no lion or rhinoceros was roused (Babur, 1922). While travelling from Agra to Patna on 2 December 1665, Tavernier (1924), in a place called Gianabad, saw one domesticated rhino in a village.

In 1590, the Moghul Emperor Akbar (1556-1605) said that the Rhinoceros was found in the "Sarkar of

Table 2: Fossil remains of Greater One-horned Rhinoceros

Country	Site	Era	Reported by
India	Ganganagar, Rajasthan	3500-400 BC	Banerjee and Chakravorty (1973)
India	Langhnaj, Gujarat	Pre-Pottery	Zuener (1952), Lutton-
India	Lake Kanevel, Gujarat	phase	Brock (1965)
India	Siwalik Hills	8000-200BC	Momin <i>et al.</i> (1973)
	Mirzapur, UP	Miocene-Lower	Baker and Durand (1836)
	Banda, UP	Not Known	Falconer and Cautely (1847)
India	Chirand, Bihar	Not Known	Falconer (1868)
India	Madras, Tamil Nadu	c.1700 BC	Lydekkar (1876)
India	Gokak, Belgaum,	Not known	Cockburn (1883)
India	Kar Harappa	Not known	Cockburn (1883)
India	-	2500-500 BC	Nath (1976), Lydekkar (1880)
Pakistan	Mohenjo Daro	c.300 BC	Foot (1874)
Pakistan	-	c.300 BC	Prashad (1936)
			Marshall (1931)

Source: WWF-Traffic India Publication - 1996

Sambhal", which should be at Sambhal, a town east of Delhi. It is remarkable that he recorded the animal just from this locality (Akbar, 1949). His son Emperor Jahangir (1569-1627) hunted a rhinoceros in the Nuh Forest near Aligarh (Jahangir, 1914). The English traveller Coryat (1616) visited Jahangir's court in 1615-1616, then at Ajmer (Rajasthan), he saw two 'Unicornis' brought from Bengal.

Records about Rajmahal Hills in Bihar tell about it being once covered by forests, full of wild animals. In January 1666, the French traveller Jean-Baptiste Tavernier (1605-1689), passed the town of Rajmahal and remarked that "it was formerly the residence of the Governors of Bengal, because it is a splendid hunting country" (Tavernier, 1676; 1924). In an imaginary journey through India, Pennant (1798) too assured that the governors liked to settle in Rajmahal "on account of the quantity of game of chase, which the neighbourhood offered". The presence of the Rhinoceros in the Rajmahal Hills of eastern Bihar is recorded by several commentators of the nineteenth century. Jerdon (1874) mentioned it from "the northern edge of the Rajmahal Hills near the Ganges", while Baker (1887) knew it from the base of the Rajmahal Hills especially near Sikrighully. In contrast, Williamson (1807) stated much earlier that "the Rhinoceros is seldom found on the western side of the Ganges, though the jungles there are fully competent to afford abundant shelter".

Thomas Daniel (1749-1850) and his nephew William Daniel (1769-1837), two British artists, worked in India from September 1788 to May 1793. They made a long journey up the Ganges from Calcutta to Delhi and Agra and back, between October 1788 and November 1791. William kept a journal during most of this trip, used by Archer (1980), to describe these events. On 8 October, 1788, the Daniels reached the Ganges in their boat, and on their left they could see the Rajmahal Hills covered with thick jungle where tigers, rhinoceros and wild elephants lurked. This list of animals must have been based on tales heard from people in Calcutta, or during their voyage. The Daniels reached Rajmahal the next day. During their stay, they made one day excursion to a nearby waterfall,

the Moti Jharna or Fall of Pearls, about 21 miles from Rajmahal and two miles from the Sikragali Hills; on the way William was thrilled to see "the footprint of rhinoceros" (Archer 1980).

In 1820, a hunt was organized near the Governor-General's Camp, about 12 miles above Rajmahal. The party sighted three or four Rhinoceros, one of which was shot dead by Captain Brooke of the Commissariat Department (Cockburn, 1884, from the Bengal Hurkara of 14 December 1820). This is the only record of a rhinoceros killed in this area. The writer Fanny Parks (1850) passed here in November 1844 and noted that there should be a lot of animals in the area, like bears, tigers, rhinoceros, leopards and deer of all kinds. Unfortunately she did not see any of this herself. The rhinoceros disappeared from the Rajmahal Hills in the course of the nineteenth century, according to contemporary statements to the effect that it would be "fast verging on expiration" (Blyth, 1862).

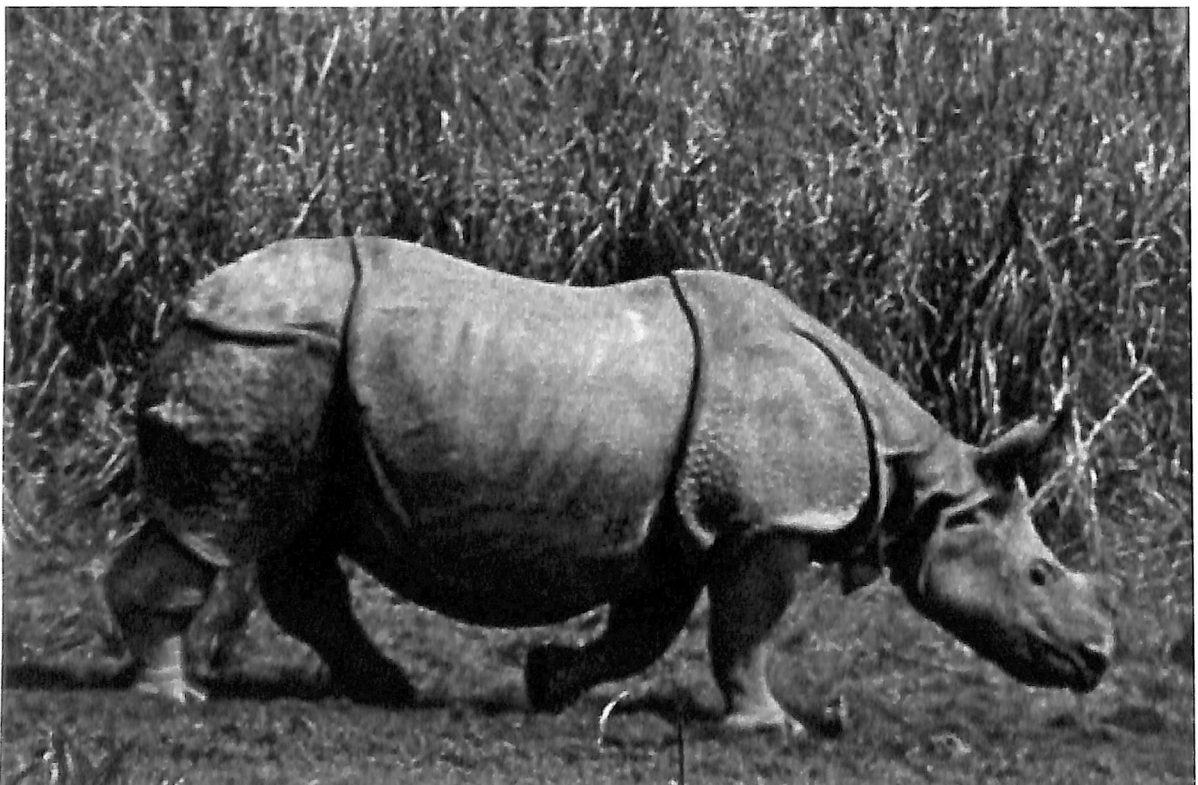
The rhinoceros was known in Purneah (Simpson, 1886), on the Kosi River of the Nepal-Himalaya (Schlagintweit, 1880), on the bank of the Koasee (= Kosi) River some 40 or 50 years ago (Baker, 1887), and on the Kosi and at Patharghatta (Manners-Smith, 1909). The collection in the Indian Museum in Calcutta included a specimen of Rhinoceros stuffed, and the bones of the feet of a male from Purneah District (Sclatter, 1891). A skull of a male Rhinoceros was in the collection of the Bombay Natural History Society presented by Mr. J. Shillingford, Purneah (Anonymous, 1887).

The rhinoceros was occasionally found in Champaran District and adjoining areas like Saharsa, Bihar (Mukherji, 1963), Gorakhpur, UP (Baldwin, 1877), and on the bank of the Bagmati, north of Muzaffarpur (Manners-Smith, 1909). Even the Emperor Babur may have meant this general region, when he recorded (before 1530), the existence of the rhinoceros on the banks of the Saru (Sirwu) River in Hindustan (Babur, 1922), where the Saru apparently means the Ghaghra River in north-eastern UP. Alternatively, Babur may have echoed the passage in the travel account of Ibn Battuta

written before 1356, in which the latter accompanies Sultan Muhammad-bin Tughluq to the city Bahrayij on the bank of the river Saru (Gibb, 1971, in a note, places this ancient town on the bank of the River Ganges). During that trip, Ibn Battuta relates that they entered a thicket of canes and a rhinoceros came out of. It was killed and the man brought its head, and though it is smaller in size than an elephant, yet its head is many times bigger than that of an elephant (Gibb, 1971). A rhinoceros was shot in Champaran in 1939 (Ara, 1954), and another in 1960 (Dutta, 1991). It is quite likely that these animals might have come from the Chitwan National Park, Nepal.

The Tarikh-i-Mubarak-Shahi in 1387 clearly narrates that prince Muhamed Khan went to the mountains of Sirmor and spent two months in hunting the rhinoceros and the elk (Yule and Burnell, 1903). Sirmor is situated on the west of the Yamuna in south-eastern Himachal Pradesh. Since then there are very few records of rhinoceros presence in these areas in the stretch from Uttar Pradesh to the Indus River.

There are four records from the Indus Valley of Pakistan and across the Khyber Pass in Afghanistan, dating up to sixteenth century. The records say that the Emperor Timor hunted and killed many rhinos on the frontier of Kashmir in AD 1398 and there are evidences that rhino existed in parts, west of the subcontinent, as far northwest as Peshawar till the sixteenth century. Babur, the founder of the Moghul Empire in India in his famous memoirs – the *Baburnamah* described how he hunted rhinoceros in bush country near the Indus as late as AD 1519. Babur hunted the Rhinoceros, which he called Karg, near Swati on the east bank of the Indus River (Suleiman, 1970). Another hunt was organized in the vicinity of Peshawar on 9 and 10 December 1526, and although the animal was pursued over a long distance, the arrows were unable to penetrate its hide (Suleiman, 1970). When Babur wanted to report his experiences and his knowledge about the Rhinoceros, he mentioned several localities in the northern part of the Indus Valley.



Pic: S.P. Sinha

The Indian Rhino is one of the largest land mammal, and can weigh up to 2 tons



Pic: Ashish Chandola

Adult male Rhinos are territorial but in good grazing areas, sometimes 2-3 males can be seen grazing along with females and calves.

Another rhinoceros was encountered by Sidi Ali Reis, member of a prominent Turkish family. In 1556, he travelled from Peshawar across the Khyber Pass and reached a village called Djushai. He wrote that there in the mountains he saw two rhinoceros (*Kerkedans*), each the size of a small elephant, they had a horn on their nose about two inches long (Vambery, 1899; Rookmaaker, 2000). As Sidi Ali probably crossed the pass before he met the *kerkedans*, this must have taken place in the extreme east of Afghanistan, in territory which can hardly be called a normal habitat for *Rhinoceros unicornis*.

The only written source about a rhinoceros in the lower Indus Valley is to be found in the narratives of Ibn Battuta who travelled from Kabul in Afghanistan, towards the lower Indus Valley in 1333. He reached the lower course of the River Indus at a spot located about 50-100 km north of Siwastian or Sehwan in the district of Larkana, Pakistan. Here he recorded that "after crossing the river of Sind called Banj Ab, we entered a forest of reeds, following the track which led through the midst of it, when we were confronted

by a rhinoceros. In appearance it is a black animal with a huge body and a disproportionately large head" (Gibb, 1971). The rhinoceros was known to the people of the ancient Indus valley civilization or Harappan culture, which flourished in the vast river plains and adjacent areas of the present Pakistan and Western India between the years 2600 and 1900 BC. Among the objects excavated at the Harappan settlements of Mohenjo-Daro on the Indus River, there were many square seals made of stone and engraved with symbols and animal motifs. A small number of these seals represent a single-horned rhinoceros (Rookmaaker, 2000). The animal is also represented in a number of clay pottery models (Marshall, 1931; Rookmaaker, 2000). In view of the abundance of the seals and pottery objects in the various excavations, we must assume that the people of the Harappan culture were acquainted with the rhinoceros, and that they knew the animal well. It is likely that they could encounter it near their settlements in the Indus Valley, either in the lower parts of the valley, or possibly slightly more northwards to where Harappa is located.

Chapter III

MORPHOLOGICAL FEATURES OF THE GREAT INDIAN ONE-HORNED RHINOCEROS

The Indian Rhino averages 170-180 cm (5'10" to 6') at the shoulders, with a girth of 335 cm (11') behind the withers and weighs around 2 tons. The Great Indian Rhino has a single horn of average 35 to 40 cm long. The skin of this massive creature is divided into great shields by heavy folds before and behind the shoulders, and in front of the thighs. The fold in front of the shoulders is not continued right across the back, a distinctive character of this species. On the flanks, shoulders, and hindquarters, the skin is studded with masses of rounded tubercles. With its grotesque build, long boat-shaped head, its folds of armour, and its tuberculated hide, the animal looks like a monster of some bygone age (Prater, 1948).

A record specimen of Indian Rhino horn exhibited in the British Museum had a length of almost 62 cm and a base circumference of almost the same. A typical horn consists of a core of bone covered by a sheath of keratin (fibrous protein). The presence of a keratin sheath distinguishes it from antlers and real horns, which when fully developed consist entirely of bone. The horn of the rhino is not a true horn because it does not have a core bone. Instead it is a compact mass of keratin fibers, not fixed to the skull and resting epidermally on a bony cushion. There are numerous instances of rhinos losing their horns which are replaced by new ones. The average weight of an Indian rhino horn is around 750 gms. In International markets of the Far-East, the price of one kilogram of powered horn cost around 40,000 US dollars. Such high prices encourage and prove to be the strongest incentive for poaching (Dutta, 1991).

In the case of the Indian Rhinoceros, identifying a male from a female in the wilderness is difficult when the animal is in the grasslands. But in the open area, if it is carefully observed, then on the basis of its genitals, the collar folds and shape of the

head can differentiate male and female. In case of males, the collar folds and head is massive as compared to female rhinos. In females the skull is slightly thinner, the base of the horn is narrower and the horn is slimmer. However for a sub-adult rhino and calf, such determination is impossible without physical examination (Dutta, 1991).

Table 3: Growth Pattern of horn in Great Indian One-Horned Rhinoceros

Age of Rhinoceros	Measurements
At Birth	No Protuberance
6 months	1.1 - 1.65 cm
1 Year	3.3 - 5.5 cm
2 Year	6.6 - 8.8 cm, Basal circumference 17.6 - 22 cm
3 Year	8.8 - 13.2 cm, Basal circumference 17.6 - 44 cm
3-20 Year	19.8 - 22 cm, fully mature horn
25 - 30 Years	Reduction in height due to wear and tear

Ecology

Basically, the Indian one-horned rhinoceros is a grazer or grass eater. It also browses on certain herb and shrub species. Rhinos are associated with water bodies which they use for feeding, wallowing and resting. It wallows (remain immersed in mud or stagnant water) during the hotter part of the day to lower its body temperature and also to get relief from ectoparasites. Rhinos feed on hydrophytes such as Trappa, Hygrorhiza, Water Lily, Nymphaea, Vallisnaria others. It has been observed that after the burning of grassland, within a week the rhino feeds on half-burnt swards of grass with dry pith, and also licks the ash on the ground (Sinha & Sawarkar, 1991).



Pic: S.P. Sinha

Wet and tall grasslands of the flood plains are the preferred habitat of the Indian Rhinos

The area which an animal normally occupies during the course of grazing, mating and rearing young ones is called its home range. A male usually has a larger home range as compared to the female or females accompanying young ones. The size of home ranges also depends upon the size of the available habitat, the nature of vegetation, the number of animals in a particular area. On an average, roughly 10 hectares of area is used by the individual rhino, differing depending on the availability of the habitat which is also shared by other rhinos.

Once the mating takes place it has a 16-18 months gestation period, and gives birth to a single calf. Usually the female rhino keeps her calf away from other rhinos and is very aggressive. This period is crucial for the new born calf as it can be killed by predators.

There are a number of causes of mortality among adult rhinos, such as internal infection and hemorrhagic septicemia, the female pregnant rhino being attacked and chased by a male rhino leading to abortion, injury due to accident and paralysis, stressful abortion and infection, anthrax and rabies. In case of calf mortality, premature death due to abortion, tiger predation, lung congestion and

pneumonia, being killed by a dominant male rhino, internal infection and enteritis are the main causes of death (Sinha and Sawarkar, 1991).

Behaviour

The Great Indian One-horned Rhino is solitary in nature with brief association of male and female during mating after which they separate. The calf stays with its mother for at least four years. From time to time rhinos meet with each other in the common ground such as grazing areas, and during mud baths in the water bodies; when they stay together without showing any aggression. This has been observed in Kaziranga NP where up to 32 rhinos wallow in a small pool of water and is tolerant of each other (Dutta, 1991, Deb Roy. *per comm.* 1999). In Dudhwa NP, 9 rhinos have been seen together in a water body. No aggression was seen amongst adults, but females with calves keep their distance from the male and keeps an eye on the movements of males (Sinha and Sawarkar, 1991).

While working in the Chitwan National Park, Nepal, Laurie (1978) observed that adult males are always solitary and avoid other males, and adult females with calves do not form permanent associations with other individuals, regardless of

sex and age. An adult female will allow an older calf to accompany her and her new-born calf sometimes a female would even drive the older calf away. Adult female with calves often associate with other females at prime wallowing areas, or in feeding areas. However, these associations are temporary. An adult female without a calf is largely solitary.

The most common and seemingly stable grouping is among sub-adults, particularly sub-adult males. Sub-adult males form groups of two to three individuals on the periphery of the core home ranges of dominant males, probably invoking the strategy of safer numbers to protect themselves or to more easily detect highly aggressive individuals. It would be interesting to apply genetic analyses to social groupings to learn the degree of relatedness of the sub-adults that cluster together. Sub-adult females are only slightly less social than sub-adult males. Dinerstein (2003) described aggregation as a short-term grouping of individuals. The most common aggregations occur during the monsoon season in forest wallows, and in *Saccharum spontaneum* grasslands during March and early April. In a forest wallow that measured about 180 sq mts, he observed as many as nine individuals, with other animals nearby. Aggregations in wallows typically included a dominant male, cow-calf pairs, and single adult or sub-adult females, but never saw dominant males sharing wallows with a sub-adult male.

Mating among rhinos is initiated by the female rhino running around a potential breeding male by making loud sounds and frequently squirting urine. During this, the female rhino pushes the male rhino. The male rhino chases the female rhino for hours, till the female rhino is exhausted and stays in one place, when mating takes place. If another potential male is nearby, then a violent fight between the two takes place, and on a number of occasions this is fatal, and the male can even lose its horn. In Dudhwa NP, in 1988, one of two fighting males lost its horn, became submissive and died. It has been also observed that the female rhino mated while accompanying her 4- year old calf. Later the calf gets separated from its mother. Among rhinos sexual maturity starts at the age of 7 years in males and 5

years in females. It has been recorded in 3 cases, among the reintroduced rhino population in Dudhwa NP that a female rhino which mated within the age of 7 years, always aborted (Sinha *et al.* 2001).

Mother always tries to keep her calf away from the male. It has been also observed that on a number of occasions, the dominant male of the area accompanies the young calf while its mother is busy grazing. The moment the mother becomes conscious of the presence of a male near her calf, it chases the male away. The male calf when separated from its mother usually keeps company with other males of his age group, and tries to keep away from the dominant male of the area. Tolerance between female and female is greater as compared with males. Since tiger and rhinos share the same habitat of flood plain, the tiger is the main predator of the young calves especially 6 months to one year of age. It has been observed that when the mother rhino is unguardedly grazing, the calf usually moves away from the mother. This is the time when it is preyed upon. Females try to chase the tiger away as far as possible. During this chase the mother rhino loses contact with her calf, and it has been observed that the tiger gets enough time to kill the separated calf, as has been observed in Dudhwa NP.

Communication

The Indian Rhino communicates using at least ten vocalizations and by urine, faeces and scent (Dinerstein, 2003). Communication through vocalization from the snort, which is an explosive sound, is often made during encounter with another rhinoceros, either approaching or being approached. Laurie (1978) observed that the number of snorts range from one to twenty, averaging about two per episode. Honk is loud vocalization that travels over long distances, often uttered during head to head confrontation, or typically during the ensuing fight and chase of one animal by the other. In most cases, the loser of this encounter does the most honking. Bleat is a sound associated with submission during head to head encounters or during courtship chases. Roar is a vocalization confined to intense encounter, both between males and females and between females.



Pic: Ashish Chandola

A calf sometimes stays with mother up to 3-4 years till another is born

Squeak-pant is one of the most charming and incongruous vocalization uttered, typically by males during courtship chases. Moo-grunt is low intensity contact call between mother and calves that unlike the other calls can be heard for only a short distance. Other much less common vocalization includes shrieks, groans, rumbles and humphs. Communication between rhinos is through audible and ultrasonic sound in varied frequencies (Laurie, 1978).

Olfactory Communication

Few displays are as spectacular as the squirt-urination that dominant males practice. Although both sexes are capable of squirt-urination, dominant males regularly eject urine as far as 3-4 metres behind them, whereas females do so only during apparent periods of estrus. Dominant bulls perform this behaviour often when approached by an observer on elephant-back. Squirt-urination is also associated with other behaviour in males, such as foot dragging and horn and head rubbing on vegetation. Laurie (1978) identified seven context associated with urination, ranging from disturbance by an observer to entering water.

According to Dinerstein (2003) defecation is an important tool for dispersion of seeds of fruit ingested by rhinos. Laurie (1978) observed that majority of defecations occur within 10m of existing latrines. A mother's defecation often stimulates her calf to do the same. In the Dudhwa National Park, the rhino uses the roadside in the woodland areas and a series of dung piles are found in a 4 km long road. Sinha and Sawarkar (1991) recorded 85 dung piles on roads inside the rhino area in the Dudhwa National Park.

The Indian Rhino reacts to the scent of other conspecifics by sniffing the ground or vegetation where other males have sprayed urine. They typically engage in *fleman*, also known as lip curl, a behaviour shown by both males and females; rhinos also use this to assess reproductive status. Rhinoceros possess pedal scent glands, which they use to mark their presence at, or in the vicinity of a latrine. Pedal scent helps to track each other and shows the reproductive status of an individual, and they can identify each other by sniffing the pedal gland secretion left behind by the passer-by on the path ways.

Chapter IV

INDIAN RHINOCEROS IN RELIGION, MYTHOLOGY, BELIEFS AND RITUALS

According to Dutta (1991) from ancient times man has woven a web of mythical beliefs around the Indian One-horned Rhinoceros. One of the earliest legends that evolved in connection with this animal was that of the *Unicorn*, a fabulous animal which ancient accounts, significantly described as being an inhabitant of India. The *Unicorn* was depicted with the body of a horse, but larger in size, bearded and with cloven hooves. On its forehead grew a single helical horn, perfectly straight, about 0.5 metre to 1 metre long. The horn was coloured white at the base, black in the middle and red at the pointed tip. The mythical Unicorn was first depicted in the earliest Mesopotamian pictorial art. It was referred to in the ancient myths of India, South East Asia and China.

In China, as early as the 27th B.C., appeared a mythical creature, a prototype of the Unicorn, called Ch'1-Lin. Ctesias (400 B.C), in Greek, described a single-horned animal of the size of a horse, white-bodied, purpleheaded and blue-eyed, with a half metre long horn coloured red, black and white. Despite its polychromatic attributes, the actual model for Ctesias's description matched the Indian rhinoceros!

Marco Polo, the famous thirteenth century traveller, who visited Asia, described the fabled Unicorn in his accounts. Again the actual beast described by Marco Polo was probably the Indian One-horned Rhinoceros. Many pictorial depictions in the medieval art of Europe, the Islamic world and China depict the hunt of the Unicorn (Dutta, 1991).

The Unicorn was an enigmatic symbol and was used by the church as an allegory to interpret Christianity. The Bible compares the Unicorn to Christ, who rose up the horn of salvation for

mankind. This idea was elaborated in the western medieval world in to allegories of the birth and death of Christ.

Hindu mythology also placed the Indian rhino on a highly revered pedestal. According to one popular legend, the rhino was created as a "*Bahan*" (vehicle) for Vishnu, one of the members of the Hindu trinity. At that point of time, the rhino did not have a horn on its snout. After saddling the beast God Vishnu mounted it, but this animal proved to be obstinate and did not obey any commands. It moved in its own way which made Vishnu angry. The preserver, in his wrath, took off one of the *kharams* (wooden clogs) he was wearing and threw it at the animal. The rhino, beholding Vishnu's rage, did not flee, but bowed its head reverentially. The *kharam* hit it on its snout and was transformed into a horn. Since the horn is made of an object that touched the feet of God himself, it attained divine powers. Also, because the rhino had not fled, but had bowed before Vishnu, it emerged as a true devotee of the Lord (Dutta, 1991).

Another legend prevalent in the oral folk-mythology tradition associates the animal with the Ramayana, the great Indian epic. When Lord Rama went with Sita and Lakshman for 14 years of *vanavas* (sojourn in the wilderness), the younger brother took a vow not to eat food and not to look at a woman's face for the period of exile. Such a vow was needed to destroy Ravan's son, Indrajeet, who had acquired extraordinary powers through *tapasya* (a long period of meditation). Lakshmana, it is said, never looked at Sita's face, only her feet. But although he was undertaking *varta* (fasting), Sita, as the dutiful sister-in-law, continued to serve him food which he stored away. The food that was kept aside turned into an animal - the One-horned Rhinoceros - after Lakshmana killed Inderjeet (Dutta, 1991).

The Indian rhino is also linked to Lord Krishna, another incarnation of Vishnu. One such legend is used to describe how this animal acquired the armour-like platings on its body. Lord Krishna, it seems, discovered that elephants were a hindrance in war because the mahouts were easy prey to enemy archers. Looking for an alternative, he picked out the rhino, dressed one in armour, and put it under training. But the animal was found to be stupid in obeying orders, and was sent back to the forest – with its armour still on.

In Assam state, the twentieth century home of the Great Indian One-horned Rhinoceros, the Usha-Aniruddha legend once again links the animals to Lord Krishna to explain how it came to live in Kaziranga. Usha, the daughter of King Ban (King of Sonitpur), saw a handsome prince in her dream, and pined for his love. Her friend, Chitrlekha, sketched one by one the faces of all the princes of India. When her pencil drew Anirudha, the grandson of Lord Krishna, Usha recognized the prince of her dream. Anirudha learnt of her love and came to Sonitpur to fetch her. But King Ban, who was averse to the marriage, threw Usha and Anirudha into prison (Dutta, 1991).

Later Lord Krishna came from Dwarka to the Kingdom of Ban to rescue his grandson, riding a rhino. He left his *bahan* (vehicle) to graze in the plains of Kaziranga while he crossed the Brahmaputra to wage war with Ban. After the battle was over and Ban vanquished, it was time to take the lovers back



Pic: S.P. Sinha

to Dwarka. So Lord Krishna played on his flute to summon his *bahan*. But the rhino did not hear because the melody of the flute mingled with the sound of Brahmaputra water. Lord Krishna was furious and disowned the rhino. But the animal loved its new environment on the bank of the Brahmaputra, the cool ambience and the lush grass, and stayed back happily (Dutta, 1991).

An interesting corollary to such myths is the one that explains why the Indian rhino does not have hair on its body. While riding the rhino, Lord Krishna used a saddle strapped to the back and sides of the animal. Animal hide is ordinarily covered with hair which was the case with the rhino. But the heavy saddle wore the hair away from the body, and that



Pic: S.P. Sinha

is why the rhino has hair only on its tail and the tips of its ears (Dutta, 1991).

Similar legends abound in the folklore of Nepal, Burma, Thailand, other South-East Asian countries and China. The cumulative effect of such myth-making was to invest the animal with a divinity that it neither deserved nor desired. Superstitions that sprang from deification have proved to be extremely tenacious, and today, though the former reverence is absent, the false beliefs remain. This has credited the rhino's horn, flesh and other organs with almost supernatural curative and rejuvenating power, thereby contributing to its slaughter.

The list of so called, 'benefits through faith and belief', derived through the horn, flesh and other organs are indeed very long. The meat and blood of

the animals is considered to be holy- after all, this animal was created from the food meant for Gods. Even today, in many parts of India, Nepal and South East Asia, partaking of the flesh and blood of this animal is considered to be surest passport to heaven. In fact, in certain regions, a person who has consumed the flesh of rhino is in danger of being eaten himself (Dutta, 1991).

In Nepal, the flesh and blood of the animal was offered to God. After a rhino hunt, those who took part would disembowel the carcass, enter the body and offer libation of the animal's blood. In Assam, a villager who has eaten rhino flesh is given social respect. Apart from its holy status, rhino meat and blood was considered to have medicinal value. Chewing the dry meat was supposed to make one immune to dysentery (Dutta, 1991).



Pic: Ashish Chandola

In Kaziranga in India and Chitwan in Nepal, the Rhino is the major tourist attraction

Chapter V

LEGAL STATUS

The first attempt to conserve the rhino in Assam came through the Assam Forest Regulation 1891, and subsequently through the Assam Rhinoceros Prevention Act 1915 upgraded in 1954 as the Assam Rhinoceros Act. 1954. In 1908 a reserve was created in the Brahmaputra basin for protection of the rhino which was subsequently declared a game sanctuary in 1915 and renamed as the Kaziranga Wildlife Sanctuary in 1950. This was upgraded in the year 1974 to a National Park.

In Bengal, the initial Rhino conservation came through the Indian Forest Act 1927, followed by the Bengal Rhinoceros Preservation Act 1932. The Jaldapara game sanctuary was created in 1941, and was subsequently renamed as the Jaldapara Sanctuary in 1976, and extended further in 1990. The Gorumara Wildlife Sanctuary was created in 1949. This was subsequently extended and upgraded to a National Park in 1994.

The Wildlife (Protection Act 1972), which is applicable all over India currently provides protection to the Indian Rhino and its habitat. Under this Act, the Indian Rhino has been placed under Schedule-I (Part-I) which provides complete protection to the species in India.

Conservation Implications

At present, the rhino population is mainly restricted to five reserves in Assam and West Bengal in India, and three reserves in Nepal. Two major existing rhino populations are in Kaziranga NP (1850) and the Royal Chitwan NP (400 m), Nepal. The remaining rhino populations with the exception of that in Pobitora NP and Orang WLS, have a doubtful existence.

The distribution of the rhino in North Bengal used to extend up to Buxa Forest till 1950s. However, with the gradual loss of corridors between the grassland, forest and conversion of the PAs into isolated, island habitats surrounded by the tea gardens, habitations

and agriculture the species became restricted to two areas, namely the Jaldapara WLS with 80 rhinos, and in Gorumara WLS, with 19 rhinos.

Despite the protective measures and dedication of field managers and field staff to protect, the persecution of this animal continues due to the rising prices of Indian rhino horn in the international markets, especially in Far - East countries for preparing oriental medicines. In Kaziranga NP from 1983-89, a total slaughter of 235 rhinos and, mass killing in Manas NP took place. Rhinos are killed by poachers mainly for horns. New ways of poaching rhinos, by electrocution in Kaziranga NP and Pobitora WLS, Assam and using pesticide in Jaldapara WLS in West Bengal, have come to light. These examples are illustrative of the present threats to rhinos and problems faced by the field staff in protection. In a number of incidents, field guards and officers were killed during encounters with the poachers, while protecting the Rhinos.

Considering the current restricted distribution of rhinos and poaching pressure, habitat specificity and consideration to the scattered small population, it becomes imperative to reintroduce the species in suitable habitats in its former range of distribution as one of the measures to be adopted for the long-term survival of the species. IUCN Rhino specialist group and the Rhino Sub-Committee of the Indian Board of Wildlife (IBWL) recommended the establishment of an additional rhino population in India. The Dudhwa NP fulfilled all the criteria required for the reintroduction among the various sites surveyed in India by a panel of experts. Thus, Dudhwa NP became the first and the only site of reintroduction of the rhinos in India during 1984-85. Another reintroduced rhino population exists in the Royal Bardia NP and Sukhlaphanta WLS in Nepal where reintroduction of rhinos took place from 1986 to 2004.

Chapter VI

WHY THE NEED FOR RHINO RE-INTRODUCTION?

Restricted Location

Conservationists generally agree that an endangered species whose habitat type, has been, reduced and split up into separated "islands" by human impact, should live in as many of those "islands" as possible.

This reduces the risk of extinction. The same applies to the Great Indian One-horned Rhinoceros and it became imperative to create as many "islands" as possible especially in its former ranges of distribution (Schenkel, 1981). Re-introduction is necessary mainly to establish new viable breeding populations and safeguard the species from poaching and natural calamities (Mishra and Dinerstein, 1987).

Increasing population of Rhinos in Assam leading to conflict

Due to devoted efforts to protect Rhinos in the Kaziranga National Park, Pobitora WLS and in other protected areas in Assam, the population has risen and during recent years, population surplus has been observed. These animals have spread up and down and across the Brahmaputra valley. However, most areas into which the Rhinos move are used for agriculture (Schenkel, 1981). Kaziranga has an unusually high density of population and Pobitora has about 85 rhinos in 16 sq. km. area. From the point of view of conservation, the only alternative is to translocate them to other Protected Areas where they can thrive well.

Protection from natural calamities

In spite of these protective measures, the persecution of this animal continues, due to the exceptionally high price of its horn. In the Kaziranga National Park during the period of 1983 to 1989, 235 animals were killed by poachers and in the same period 368 animals died due to natural causes related to flood, old age and illness (Dutta, 1991). In the recent past, poachers wiped out the entire population of the Laokhowa Wildlife Sanctuary. Despite extremely strong protection measures, rhinos are also poached from other protected areas as well.

A natural calamity like flood is also equally disastrous for the Rhinoceros population in Kaziranga; cattle grazing is another problem for the rhino. Cattle presence in wild increases the chances of disease transmission.

The One-horned rhinoceros is a hardy animal and seldom falls prey to disease that affects other herbivores, domestic or wild. But any epidemic outbreak can cause great loss to the animal. In 1944 and 1947 due to suspected cases of Anthrax and other unidentified disease several Rhinos died in the Kaziranga National Park (Dutta, 1991). In 1979 too, hemorrhage septicemia was detected in Kaziranga National Park in 10 cases (Sinha, 1999).

Increasing the Indian Rhino habitat in as many "islands" as possible

Habitat destruction is another major problem for the rhino. The prime rhino habitats are under various threats from encroachments, cattle-grazing, agricultural activities, illegal felling and flood. Rhino habitats have been cleared in the past for agricultural purposes and developmental activities. The whole area of *terai* and flood plains of Brahmaputra is a very fertile belt. Encroachment of forest land for agricultural activity is a wide-spread problem more or less everywhere in India. Increasing the rhino habitat with strong protection is the only alternative.

Thus, considering the current highly restricted distribution with poaching pressure, and habitat specificity, and in consideration of the scattered small population, it became imperative to re-introduce the species in suitable habitats in its former range of distribution, as one of the measures to be adopted for the long-term survival of the Indian Rhinoceros. The IUCN Rhino Sub-Committee of the Indian Board of Wildlife (IBWL) recommended the establishment of an additional Rhino population in India, consequently rhinos were re-introduced in Dudhwa National Park in 1984.



Pic: Ashish Chandola

Despite the fact that very good grasslands and swampland were converted into plantation, Dudwa National Park still has suitable grasslands (above), and swamps (below) for about 100 Rhinos to thrive



Pic: S.P. Sinha

Selection of Dudhwa Tiger Reserve for Rhino Re-introduction

Large-scale poaching and habitat destruction leading to the fast dwindling population of this magnificent mega-herbivore attracted the attention of conservationists round the globe during the mid 1970s. This followed studies, surveys and discussions at international fora like International Union for Conservation of Nature and Natural Resources (IUCN). It was during the late 1970s that the Asian Rhino Specialist Group and the Indian Board for Wild Life considered re-introducing the Great Indian One-Horned Rhinoceros at suitable sites within its past distributional range, from where it had disappeared or was disappearing. This would, in their opinion, reduce the chances of the species becoming extinct.

Following up on the recommendation of the Asian Rhino specialist group, the wildlife status evaluation committee of the Indian Board for Wildlife appointed a Subcommittee to consider alternative areas for establishing a rhino population by translocation in suitable habitats. This Subcommittee considered the ecological requirements of potential areas for the re-introduction of Indian rhinoceros and established the following criteria:

- Diversity of habitat, including flooded grasslands with a variety of food plants
- Ample shade and water bodies for wallowing and drinking especially in the hot season.
- Protection from all forms of human disturbance and harassment, including pollution, poaching and the introduction of disease via domestic stock. It is equally important that conflict with cultivation adjacent to areas of re-introduction be avoided, especially in view of the rhino's liking for crops such as paddy and sugarcane.
- Translocation to an area which has not yet been inhabited by rhinos, but the area does fall under the former range of rhino distribution in the past.

Based on the above criteria, possible alternative habitats suggested were, Dudhwa National Park

(U.P.), Jaldapara (W.B.), Champaran (Bihar), Intaki in Nagaland and Lalighabri Sanctuary of Arunachal Pradesh. Among the various areas considered by this Sub-Committee, Dudhwa National Park was thought to be the most promising which met all the above-mentioned criteria.

- Dudhwa National Park was found to be the most suitable because of its significant similarities to habitats of the Kaziranga National Park. Dudhwa National Park contains diversity of habitat, including flooded grasslands with a variety of food plants and ample shade and water for wallowing and drinking.
- Adequate protection is available in the Dudhwa Tiger Reserve because of its status National Park and later as a Tiger Reserve.
- The area is a portion of the historic range of the rhino. The last one was shot in 1878 in Pilibhit district, which is also close to the proposed site.

Prof. Schenkel, the then chairperson of the Asian Rhino Specialist Group, confirmed the suitability of this site and observed, "*Dudhwa is the area most suitable for establishing a new local population of Indian rhinoceros. The area is protected, large enough and contain suitable habitat.*" This was further supported by the vegetation survey conducted by Dr. Hazra and his team of botanists from the Botanical Survey of India, which revealed the presence of several food species for the Rhino that were common to Dudhwa, Kaziranga and Manas National Park. These are:

Grasses	10 species
Herbs and climbers	6 species
Hydrophytes	6 species
Shrubs and under shrubs	7 species
Trees	12 species

Rhinos generally prefer grasses such as *Saccharum* spp., *Cynodon dactylon*, *Arundo donax*, *Polytoca digitata*, *Hygroryza aristata*, *Vetiveria zizanioides*, *Imperata cylindrica*, *Themeda* spp., *Chrysopogen aciculatus*, *Puspalidum flavilum*, *Narenga porphyrocoma*, *Phragmites karka*. The preferred sedges such as *Cyprus* spp. and herbs, shrubs and saplings

of species like *Polygonum plebelium*, *Ageratum conyzoides*, *Erigeron* spp., *Artemesia nilagirica*, *Eupatorium odoratum*, *Solanun* spp., *Colebrookia oppositifolia*, *Murraya koenigii*, *Trewia nudiflora*, *Litsaea* spp., and *Premna* sp. They also like aquatic plants such as *Hydrilla verticillata*, *Vallisneria spiralis*, *Hygroryza aristata*, *Potamogeton* sp. and *Trapa* sp. It is estimated that the rhino population in Kaziranga consumes about 77% grasses and 23% herbs and shrubs. The wide range of materials eaten by the rhinos, suggests that the animal is not very specific in its choice. However, the majority of the food plants mentioned was available in the Dudhwa National Park (Hazra and Shukla, 1982).

The UP Forest Department came forward with an area of approximately 90km² in the south-west part of the park (South Sonaripur and Bellarian ranges). It was estimated that an area of 90 sq. km can support an ultimate maximum number of 90 rhinos considering one rhino per sq. km (Sale and Singh, 1987). In addition there are other areas of good rhino habitat in the Dudhwa Tiger Reserve. In order to prevent released rhinos from wandering out of Dudhwa into adjacent cultivation, and to assist their initial establishment in an optimal habitat, a 27 sq. km area was enclosed by a stranded electric fence. A 9 km critical section near the park boundary was additionally protected against accidental escape by construction of rhino and elephant proof trench outside the electric fence. Holding stockades for the new arrivals were built within the fence zone, and the Dudhwa field staff was sent to Assam for training in rhino management.

Finally, the re-introduction of Rhino in Dudhwa took place in two phases –in 1984 and in 1985.

Analysis and Evaluation of Measures of Success

This programme started with planning during late 1970s, followed by the capture and release of rhinos from Assam during 1984, from Nepal in 1985 and the translocation of a male rhino from Kanpur Zoo during 1992. The current rhino population has

increased to twenty three by May 2007. As there were different phases of this programme's implementation, its performance was to be evaluated in the following stages:

- * Preparatory Phase
- * Operational Phase, and
- * Establishment Phase

Preparatory Phase

After having decided to re-introduce rhinos from Assam to Dudhwa, the most challenging job was to capture them from the wild without causing injury to the animals, transport them safely and release them. All these operations needed an in-depth knowledge of biology and behaviour of animals and suitable techniques. There was no experience of capturing the Great Indian One-Horned Rhinoceros by chemical immobilization at that time, so, the noted specialist in wildlife management with specialization in drug immobilization of large animals, was vested with the responsibility of suggesting technique for capture, handling and transportation, training to field staff and leading the entire operation.

Dr. J.B. Sale and Dr. Woodford (Consultant Wildlife Veterinarian) conducted capture trials in Assam between 7 January and 12 February, 1980. The team captured five animals (all males), out of which four were transported to holding sites specially set up for this purpose. Capture and transport techniques were developed by the team and training was imparted to field personnel and veterinarians. A full report on this trial operation was published on the 5 March 1980. The report gave detailed procedures recommended for the capture and release operation. The report gave details of five successful immobilizations but did not mention any attempt of immobilization that might have failed, or of any casualty. Moreover, all the five animals captured were males. Had a few females also been captured, a better know-how in special care to be taken while capturing female rhinos might have been developed.

Operational Phase (Capture, Transport and Release operation)

The Wildlife Status Evaluation Committee of the IBWL suggested that a minimum number of ten rhinos might be translocated to Dudhwa National Park on an experimental basis. A capture team led by Dr. Sale conducted the capture operation between 15 and 21 March 1984 in the Pobitora Wildlife Sanctuary, Assam. All were captured by darting, using doses between 1.0 to 2.0 ml Immobilon (etorphine and acepromazine mixture, Reckettes, UK) that was reversed by Revivon (diprenorphine).

Three of the rhinos walked directly into crates placed immediately in front of them, as a result of administering small doses of Revivon, and guiding them forward with ropes. Resultant recovery from immobilization took place. The other two had to be transported about 1.5 km from capture site to crates on sledges. They were revived after the sledge bearing them had been inserted into the crates. All animals except one female quickly settled in the stockades and were eating well after a few days. During this capture operation, six animals were captured, of which one died at Guwahati Zoo (Sinha, Sawarkar and Tiwari, 2001). The remaining five animals comprising one adult male, one sub-adult male, two adult females, and one sub-adult female, were kept in the stockades.

Five animals were transported to Dudhwa having been airlifted from Guwahati to Delhi and then onwards by trucks. Three of the animals were given pre-flight sedation (between 10 and 20 ml azaperon) and all behaved well during the 150-minute flight to Delhi. After food and water at Delhi's Palam airport, the crated animals embarked on an 18-hour truck journey to the Dudhwa National Park. Immediately on arrival, they were released into individual stockades. All the animals were kept in holding stockades for a minimum of about three weeks to recover from the shock of tranquillization, and to get used to the energized fence. One female died following a stressful abortion after eleven days at Dudhwa (Singh and Rao, 1986). Three of the remaining four were released on 20 April 1984 and the remaining one, which was a dominant male,

was released in the main fenced area after radio collaring on 9 May 1984.

The second translocation of the rhino to Dudhwa was taken up from Nepal during March- April 1985. Four females estimated to be between 5 and 7 years were captured by immobilization from the Chitwan National Park. These animals were sledged into crates in which they were revived. They were driven 720 km to Dudhwa and all withstood the 24- hour journey well, with the exception of the first arrival, who broke out during the first night, but quickly settled in the wild after a week.

In the two operations, a total of ten animals were captured (six from Assam and four from Nepal) by drug immobilization. Out of six animals captured from Assam in 1984, two died within a fortnight after being captured. One of the animals died at Guwahati Zoo and the other at Dudhwa. The female that died at Dudhwa was presumably in an advanced stage of pregnancy. Another adult female was in good condition when released on 20 April 1984, but developed a limp shortly after, and also had a troublesome open sore on her back. In order to investigate and treat both ailments, the rhino was immobilized on 7 May 1984. On rising after revival her right forelimb was seen to be paralyzed, apparently due to nerve damage while recumbent (Sale. and Singh, 1986). In spite of intensive veterinary care the animal finally died on 31 May 1984.

The capture operations of 1985 handled by the Nepalese forest authority were better in various ways. First, only sub-adult animals were captured, thus minimizing the possibility of any pregnant animal being captured as had happened in the case of the Assam capture. Secondly, there was no casualty after the translocation operation and all animals settled well in Dudhwa. But in 1991, one adult female of this group died because of the internal infection and abortion, after she fought with the dominating male to save her male calf (Singh and Rao, 1985). Re-introduction from Assam, as compared to that from Nepal had a basic difference of distance in the destination, from the origin. Nepal

being nearer to the re-introduction site allowed ease and economy in operation. This may also be a reason of the re-introduction from Nepal being more successful as compared to that from Assam.

Establishment Phase

A total of 10 rhinos were translocated to Dudhwa from 1984 to 1992. However, the last arrival at Dudhwa, a male from Kanpur Zoo, was sent back, as it could not contribute in breeding. Out of the remaining 9 animals, one could not even be released in the wild but died in the holding stockade, one died in May 1984 and one more died in 1989 of injuries inflicted during its fight with another male. So, the founder population for this programme was six animals. This founder population of six had only one male and five females, but increased to 23 by May 2006.

One wild female rhino had found her way into the Rhino Reintroduction Area. She must definitely have belonged to the population in the Royal Bardia National Park in Nepal. She died when attacked by Bankey, the lone dominant male in Dudhwa.

Before the breeding of the re-introduced population could start off, several problems were faced. By the end of 1984, the year of translocation of rhinos, Dudhwa had only three individuals (two males and one female). After receiving four females from Nepal in March-April 1984, the Dudhwa population had two males and five females. But, at this point of time a serious fight started, particularly between the two males for dominance. The larger male named Raju asserted its dominance in the beginning. The other

male named Bankey, with the passage of time became more and more aggressive, resulting in frequent fighting between the two. During mid 1988, in one fight Raju broke his horn, and thereafter, Bankey became the dominant male. Raju was chased out of the fence time and again. A fence was created to separate them but the fights continued and in a final fight Raju sustained fatal injuries and died in December 1988. As a consequence of the death of Raju, Bankey remained the only breeding male of the population.

The females re-introduced at an early age of about 5 years (as in case of the animals from Nepal) adapted better. There had been no casualty during or after capture and release operations. Performance with respect to breeding success has been better in the case of animals re-introduced at the sub-adult stage. Out of the three females brought from Assam, the two elder ones died within three months, and consequently the Dudhwa population had only one 4-year old female and two males (one 7 year old and another 25 year old). In 1985, four females, all below 6 years of age were brought in. The period from 1984 to 1989 may be considered as a pre-breeding establishment phase as all five females were sub-adult. With the death of the old male in 1988, the entire population was of uniform age structure with high breeding potential. In 1989 four of the five females successfully calved. The experiment very clearly indicates that success in case of sub-adult individuals, and also, failure in case of old aged individuals. There has been no casualty in case of sub adult- females, whereas the adult females died. Furthermore, these sub adult- females alone have contributed to breeding.

Table 4: Causes of Adult Mortality in Dudhwa from April 1984 to February 2002

Cause of death	Number
Internal Infection and hemorrhagic septicemia	1
Injured by male attack and abortion	2
Injured due to accident and paralyzed	1
Stressful abortion and infection	1
TOTAL	5

Table 5: Causes of Calf Mortality in Dudhwa from April 1984 to February 2002

Cause of death	Number
Premature Death/Abortion	6
Lung Congestion/Severe Infection	2
Killed by dominant Male	1
Internal Infection / Enteritis	2

The first evidence of breeding in the re-introduced population was detected in the form of the remains of a newly-born calf in a patch of tall grasses in August 1987. There was no sign of predation indicating a possibility of premature birth. The first successful calving occurred in early 1989. Three more calvings followed in the same year.

After the death of Raju in 1988 and the failure to introduce a male from the Kanpur Zoo, Dudhwa did not get any other adult male from outside, even after a lapse of about 14 years. As a consequence, only one male was mating with all the females of the population, so a single male has sired all the calves born in the Dudhwa Tiger Reserve. This has resulted in:

- a. Slow rate of population build up, and
- b. Severe inbreeding.

Had there been a few more males capable of participating in breeding, the birth rate in the population might have been much higher. At the same time, there would have been a genetically healthy population. As the same male sires all the calves, and that male continues to dominate, the females of the progeny are mating with their sire. This is a major hindrance to the programme of rhino propagation. The population as of now is heavily inbred and this trend should not be allowed to continue. This is a classic example of how small populations suffer the threat of extinction. It was not known that out of two males, one was going to be totally ineffective for the breeding programme, and that only one would participate totally in the breeding. An attempt to tide over this problem was made by bringing one male *Lohit* from Kanpur Zoo in 1992, but Bankey did not allow *Lohit* to even settle down at Dudhwa. *Lohit* was seriously injured by Bankey and was sent back to the Kanpur Zoo after treatment. Now, the situation is that, even if Dudhwa-born males establish them, they will be mating only with close relatives, which is genetically a totally undesired proposition.

Fence Maintenance

The re-introduced rhino population is enclosed within an area of 28.11 sq. km fenced by a four strand

energized fence. Two energizers power this fence, one each at Salukapur and the Base Camp. The facility of solar power run chargers is available for charging the batteries. This system is effective and useful in open weather, but during the rainy season, arrangements are made to get them charged in Dudhwa or Palia Town.

Proper maintenance of the fence is very important for the success of the rhino re-introduction programme. If the fence is ineffective the rhinos will start straying in all directions, which will not be within manageable proportions for the park authorities. That is precisely why the management lays due emphasis on maintenance of the fence. A total of eight fence watchers are engaged on a daily basis for the maintenance of this fence. Apart from fence watchers, other departmental personnel are also given the responsibility for the maintenance of the fence. There is a well-laid out system for the purpose. Duties assigned for each of functionaries are as follows:

- **Fence Watcher:** is supposed to walk along the entire length of the fence under his jurisdiction from 9.00 A.M. to 5.00 P.M. While walking, he is supposed to check the fence, and clean all vegetation, tighten strands, insulator and poles if needed. In case of any breakage, the fence watcher is supposed to report to the Beat Officer.
- **Beat Officer/Fence Supervisor:** to ensure that proper duties of all the fence watchers within his jurisdiction are preformed and act immediately on reports of these fence watchers. Five fence supervisors are deputed for the maintenance of the entire length of the fence. Five different fence sectors have been identified and five fence supervisors are made responsible for the entire length.
- **Section Officer (Forester):**
 - * Surprise checking of the duties of the fence watchers and the Beat officer
 - * If any rhino is not seen for a long period, to scan the entire area and locate it

- * To check the voltage of the fencing
- * Walk on foot and check the fence at least twice a week
- * Maintain store for fence upkeep
- **Range Officer:** is supposed to ensure proper duties performed by Fence Watchers, Fence Supervisors and Section Officers and the proper maintenance of the fence. He is required to walk and check the entire fence twice a month.
- **Wildlife Warden:** is supposed to co-ordinate fence monitoring by a surprise inspection of batteries, energizers and other fence materials. He is supposed to walk the entire length of the fence once a month.

In the given circumstances, it is quite obvious that the management is trying its very best for the better management of the fence and it is satisfactory. But there are problems in arranging funds for the proper upkeep of the fence.

Monitoring

Due emphasis is laid on regular and thorough monitoring of the rhino population at Dudhwa. Monitoring is done by scanning of the area by

elephants, from watchtowers, on foot and on motorbike. There are four elephants deployed for this purpose. Two elephants are stationed at Salukapur and an equal number at the Base Camp. Four teams monitor different areas within the Rhino Enclosure. They try to locate rhinos, identify them and observe their activity.

Daily observation of sighting location, activity when sighted and any unusual behaviour are recorded in registers maintained at the two camps. A consolidated monitoring report is taken by the Range Officer and submitted to the Deputy Director every fortnight. This fortnightly rhino monitoring report is forwarded to the Director, the Dudhwa Tiger Reserve and up to the Chief Wild Life Warden, Uttar Pradesh. This is a very effective monitoring system and any problem arising at any point of time is likely to be detected at an early stage. At present, monitoring is done with three elephants, as one of the elephants died recently. In the monsoon months, it is very difficult to ensure effective scanning and therefore additional elephants are deployed.

Every day, rhinos located are thoroughly scrutinized for wounds or scars. If any fresh wounds are noticed, usually medicines are sprayed with the help of pumps. Dung samples are collected in all seasons

Pic: Ashish Chandola



Forest Officers examining a naturally died Rhinoceros in Kaziranga National Park

to estimate the parasite load. The parasite load, however, has never been a problem in the reintroduced population of Dudhwa. Professional veterinarians at Chandan Chowki and Palia, are consulted as and when necessary.

Parameters for Identification of the Individual Rhino used for Reintroduced Rhinos in Dudhwa National Park and Tiger Reserve:

A. Determination of male and female rhinos by observing the following:

1. External genital organs – both the sexes can be identified
2. Size of the body, head and horn is massive in the male
3. Female accompanying calf
4. Way of urination
5. Neck/collar folds massive and bigger in size in case of the male

6. Udder protuberance in case of adult females

B. Characteristic features for identification of individual rhinos in Rhino Reintroduction Area in Dudhwa NP (Table 6)

1. Shape and size of individual rhino horn variation
2. Major wound marks on different parts of the body
3. Shape and size of ear pinna
4. Tail size and length
5. Pigmentation patch between horn and upper lips
6. Temperament of rhino varies from one to the other.

Individual rhino should be photographed showing any particular trait that will help in identifying individual rhino in the field.

Table 6: Identification features of adult reintroduced Indian Rhinos studied in Rhino Reintroduction Area in Dudhwa National Park

S.No	Name	Collar Folds	Shape & Size of Horn	Shape of ear pinna	Shape of pigmentation upper lips	Other traits
1.	Banke (Male)	Massive collar folds	Long pointed with narrow furrow	--	--	Aggressive
2.	Pabitri (Female)	--	Small and pointed	Square patch of pigmentation	--	Very calm and quite
3.	Himrani (Female)	--	Small and founded	Left ear pinna round hole and folded	--	Calm and quite
4.	Narayani (Female)	--	Long and pointed	Two white ring shaped patch	--	Very ferocious aggressive and tries to attack
5.	Rapti (Female)	--	Short, base bigger with broken tip	Big and rounded	--	Very calm
6.	Swayamvara (Female)	--	Sharp and pointed tip	--	--	Long tail

Chapter - VII

CAPTIVE ELEPHANT MANAGEMENT FOR INDIAN RHINO AT DUDWA

As monitoring depends to a great extent on the number and proper management of captive elephants, it becomes essential to take stock of the manner in which captive elephants are being managed and kept at the Dudhwa Tiger Reserve. The observations made during the study are as follows:

- * The general health of most of the animals is poor
- * Hygiene at the elephant camps is far from satisfactory
- * Proper control on quality and quantity of rations and fodder fed is lacking. Ration Register, Medical Register and Service Book should accompany each elephant wherever it is deployed. But, unfortunately these essential documents are not available at the camps. There is no utility if the register if it is not kept at the elephant camp. In such a condition it is very difficult to ensure that feed as earmarked has actually been fed to the animal.
- * **Weight of Gaddi** – is a very important consideration in captive elephant use. Whereas in other parts of the country this weight is well below 100 kg, that in Dudhwa is 200 kg. This is supposed to have a deleterious bearing on the health of the animals. Whereas in Jaldapara, there is a different lightweight 'gaddi' for patrolling purposes suited for long duty periods, in Dudhwa the same one is being used for both purposes. A fair load for an average elephant is about 1000 lbs as per Evans (as cited by A.J.W. Milroy's *Management of Elephants in Captivity*, edited by Bist S.S. 2002).
- * **Duty hours** – With the opening up of the Rhino Reintroduction Area for tourism, animals are used for long period, that it is deleterious for elephant's health. Elephants should not be worked for more than 5 hours at a stretch and given complete rest during midday.

Habitat Management

Grassland management strategy adopted in the Rhino Reintroduction Area is the same as followed in the other parts of the Park. Management interventions here can be categorized into two broad categories:

- * Cool season burning, and
- * Harrowing followed by burning- is done once immediately before the onset of the monsoon and once after the monsoon

Cool season burning is a one-time intervention, whereas the second one is done twice each year. The park management considers the monsoon as the pinch period from the fodder availability point of view. In order to provide more of palatable grasses for the herbivores during the rainy season, portions of grasslands are first harrowed and then burnt immediately before the monsoon and also after the monsoon. This certainly gives rise to new shoot, cherished by all herbivores. But, it seems important to study the effects of this practice on the overall health of the grassland eco-system. One thing is definite, that if this practice is continued in areas adjacent to water-bodies, their siltation is bound to accelerate.

As far as cool season burning is considered, the entire grassland is burnt every year in a mosaic pattern. On the areas used by Bengal Florican, grass is cut prior to burning in patches in a mosaic manner to provide a mosaic of tall and short grasslands. The areas used by Hispid Hares are supposed to be protected from fire.

Problems

In-breeding

As discussed earlier, all individuals of the Dudhwa bred population are sired by single male rhino. There is no other unrelated male currently, and all the mating of the Dudhwa bred population is taking place between close relatives. This is certainly a very discouraging reality.

The original target was aimed at releasing 30 rhinos, but due to financial and administrative constraints only 10 could be released from 1984 to 1992. Four out of these ten have died and another one from the Kanpur Zoo has been sent back. So, breeding started with one male and five females. During about 19 years of breeding, a total of 28 calves were born out of which 18 are surviving. There had been 4-recorded cases of abortions. The total population size as of now, stands at 23 (May 2007).

The problems of in-breeding as well as the desired response to the stochastic eventuality need to be addressed. These are rooted in genetic variability as well as in numbers. These need to be overcome with further restocking from large populations. The original number of 30, though not a magic number,

needs to be considered. More animals could be brought from Nepal or Assam and all need to be from the wild, and those that are not 'nuisance' animals habituated to crop raiding.

Intra-specific Fight

Right from the beginning, there has been a serious problem of intra-specific fights between males as well as between male and female. As a consequence of such fights, one of the two males of the first group was killed. Owing perhaps to this very reason, Narayani a female from Nepal is presently staying outside the fenced area. Narayani even gave birth to her last calf in a sugarcane field in Bela Kalan village about 4 km from the Rhino Reintroduction Area.

As suggested by experts, it is necessary to enhance the fenced area to include more of swamps, wallowing grounds, grasslands and upland forest habitats to prevent intra-specific fights. Sinha and Sawarkar (1991) suggested extending the area to include Gupti Phanta area including Road No 60, leading towards Belraiye. They have suggested creation of artificial wallows to enable more extensive utilization of the habitat, and also to help reduce intra-specific competition.

Table 7: Details of potential breeding population of the Indian Rhino in Dudwa

Sex	Name	Origin/Born on	Age in May 2007
Male	Bankey	From Assam	30 years
	N-3	31.07.92	15 year 8 months
	S-2	10.08.91	16 year 7 months
	P-3	02.10.97	10 year 5 months
Female	Pabitri	From Assam	27 years
	Swayamvara	From Nepal	27 years
	Narayani	From Nepal	27 years
	Himrani	From Nepal	26 years
	H-1	02.02.89	18 years 5 months
	N-2	01.06.89	18 years 9 months
	H-2	05.08.92	15 year 7 months
	S-3	07.10.94	13 year 5 months

Straying out of Indian Rhinos

For the last two years, some Indian Rhinos, especially Narayani, have started straying out of the park. A rapid survey in the villages Bela Kalan, Bela Tapar and Gulra Tanda and interaction with the forest staff of Gulra Chowki indicated that there have been 11-recorded cases of straying out by rhinos. There has been crop damage, but no other damage has been reported so far.

Although, the problem of animals straying out is not of a very serious dimension from the depredation point of view, this trend is not very good for the rhino re-introduction programme. Since in most cases, only one individual is straying out, that too during her pregnancy, chances are that it is a part of her strategy to avoid Bankey. But it has to be seen as the calf grows. Whatever may be the reason, the fact is that the fence and the 9 km elephant proof trench is not being maintained as it should be.

Resource Crunch

The park management faces difficulties in procuring money for taking up the following activities in a regular manner:

- * Fence maintenance
- * Wages to fence watchers

- * Maintaining elephants for rhino monitoring and a recent need for tourism.

Apart from ongoing activities, large sums are needed to create and maintain a 9 km long elephant proof trench as prescribed by the Rhino Sub Committee at the beginning of the project. Such a trench is extremely important to check straying out of rhinos that may even lead to poaching. Additional money would be required to procure elephants for monitoring and for tourism purposes. This again is a vicious circle, as it would require recurring expenditure on the maintenance of elephants. Such recurring expenditure is to be anticipated in advance and sources ensured.

Tourism

Park authorities have opened the Rhino Reintroduction Area for tourism from December 2001. Earlier this area was supposed to be a restricted zone, sanctum sanctorum, and nobody was allowed to enter the area. These monitoring elephants are kept on long duty hours in locating rhinos. The same elephants are used to make a number of trips for the tourists in rhino shows. This practice should be discontinued or reduced to three days per week. There is also a need of regular checking of the amount of prescribed food provided to individual elephants, and health care measures, by the veterinary officer.



Pic: Ashish Chandola

Controlled burning of grassland is necessary for maintenance of the *terai* grasslands.

Poaching

At present the park management is very alert, patrolling duty is being done religiously, and rhinos stray out only in rare cases, so poaching does not seem to be a problem. But, its possibility still remains.

Biotic Pressure:

Villages like Bela Kalan, Bela Tapar, and Gulra Tanda are located near the southern fringe of the power fence. People from these villages, at times, venture into the Rhino Reintroduction Area for collection of thatch grass, fodder and at times fuel wood and for fishing in the swamps. The addition of the southern buffer has helped in reducing the problem to some extent. It has been observed that in the past, the theft of fence wire was directed at preparing snares by local poachers to snare deer found in the Rhino Reintroduction Area. Daily monitoring of the entire length of fence and monitoring rhinos with the help of elephants has contained the biotic pressure to a low level, but even so, it remains a constant threat.

Lack of Veterinary Facility

There is a sanctioned post for a veterinarian in the Dudhwa Tiger Reserve, but no one has joined considering the current salary scale and bleak promotional prospects. Veterinary doctors are called from Chandan Chowki or sometimes from Palia when required. From time to time a Veterinary officer and Veterinary scientist from Lucknow Zoo and the Indian Veterinary Institute, Izzatnagar, Bareilly, visit this area. Due to these reasons it is difficult to get timely medication. On many occasions, doctors are not available or not well-versed with the wild animal, in providing the correct doses. It is very difficult to ensure appropriate health care of the camp elephants and rhinos without having proper veterinary care facilities under the existing conditions.

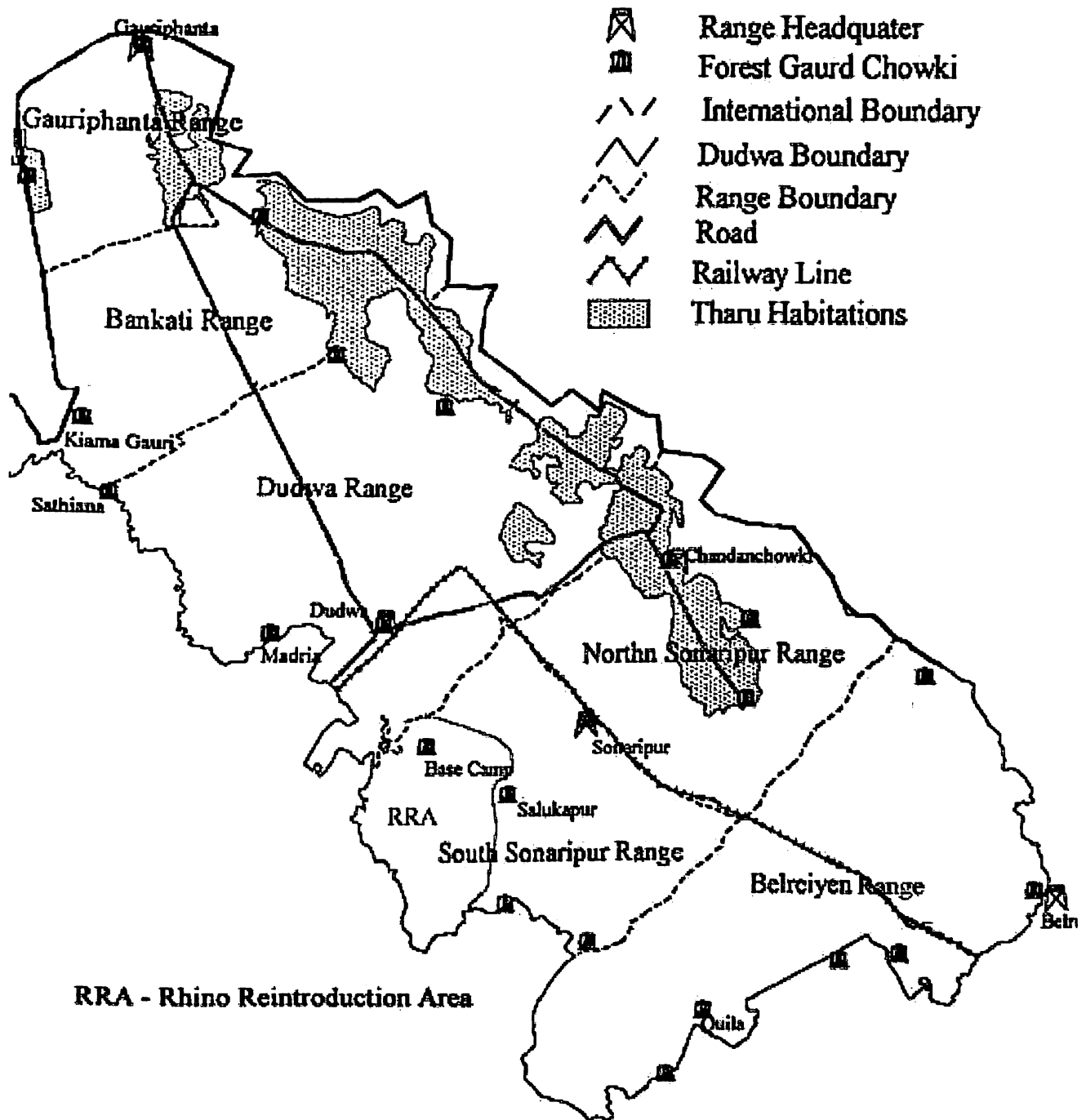
Suggestions for Improvement

- * Procure a few (in the ratio 1 male to 3 females) from the wild.
- * In all future re-introductions, only sub-adult individuals of the same age group should be

brought, as there are less chances of casualty, and they do adopt better to new conditions. Moreover, by having males of the same age group, there may be a lesser possibility of over-dominance by one individual.

- * Develop alternative rhino area within the Dudhwa N.P.
- * Maintain the 'Rhino Proof Trench' on the southern side of the Rhino Reintroduction Area.
- * Restrict Rhino watch by tourists to 3 days per week within the Rhino Reintroduction Area until necessary infrastructure and facilities are properly developed
- * Procure additional riding elephants (4 for daily monitoring and 2 elephants for tourists).
- * Long-term studies on Grassland Management, habitat use by different large and small mammals and regular monitoring of the population of highly endangered species such as Swamp deer, Bengal Florican and Hispid Hare. This is only possible by creating a permanent research and monitoring station at Salukapur funded by national and international funding as an independent body. Such long-term studies and monitoring will not only help in the future management of rhinos, but in the habitat management as a whole.
- * The State Forest Department must allow the revenue generated from tourism activities to be ploughed back into the developmental activities and maintenance of infrastructures of the Park and welfare of the forest staff.
- * Since obtaining funds is one of the major concerns, the Park authority with the consent of State Forest Department can create a registered Wildlife Welfare Society or Foundation to be looked after by the Deputy Director of the Park, on similar lines as is being done in Madhya Pradesh and Gujarat. This society/foundation should be allowed to accept donations and funds from different funding individuals and agencies for conservation activities and welfare of the staff of Dudhwa.

Dudhwa National Park



Chapter VIII

NEED FOR ENLARGING THE GREAT INDIAN ONE-HORNED RHINO HABITAT, AND TRANS-LOCATION OF RHINOS IN BHADHITAL AREA IN DUDHWA NATIONAL PARK

The Rhino Subcommittee of the Indian Board for Wildlife (IBWL) has identified the Bhadi-Churaila sector in the Belreiyen Range as one of the possible sites for re-introduction of rhino in their original recommendation. In 2002, an additional area for the rhino within Dudhwa was selected. The area falls in the Bhadi-Churaila sector of the Belreiyen Range. This area provides water for drinking and wallowing, shade, and an adequate variety of plants known to be eaten by rhinos elsewhere. One of the essential prerequisites for rhino re-introduction is vast grassland with water for drinking and wallowing. This Bhadi-Churaila sector has two permanent water bodies known as Bhadi Taal and Churala Taal respectively. Apart from these two permanent and large water bodies, there are various

other smaller water bodies, which are permanent as well as, seasonal.

The advantage of the area selected is that it is in the central location of the Belreiyen Range. There is no danger of rhino wandering into the human occupation and cultivation areas, in case of operation failure of the power fence. While in the case of existing rhino re-introduced area, it is adjacent to the southern boundary of the Park, which lacks a buffer zone and outside of which is an area of dense human occupation and cultivation. Bhadi-Churaila sector is centrally located, and a sufficient buffer is available and comprises an area of 10.74 sq.km. Unfortunately the proposed work was stalled due to a number of reasons.

Table 8. The Bhadi-Churaila Habitat

Range	Block/Compartment	Sal Forest (ha.)	Grassland (ha.)	Wetland / Swamps (ha.)
Belreiya Range	Bhadi-2	180.09	-	-
	Bhadi-3a (Part)	-	30.00	105.00
	Bhadi-3C	18.21	354.88	105.00
	Bhadi-6a	88.63	-	-
	Bhadi-6b	-	106.43	-
	Laudaria-2 (Part)	35.39	-	-
	Laudaria – 3B	4.04	96.62	24.00
	Laudaria – 4 (Part)	9.72	20.30	-

(Source: Proposed Plan for Bhadhital Rhino Area, 2002-04)

Total area = 1,073.31 ha = 10.733 sq. km

Total length of the fence perimeter = 17 km

Chapter IX

RECOMMENDATION AND ACTION PLAN OF IUCN/SSC/RSG ON THE GREAT INDIAN ONE-HORNED RHINOCEROS IN INDIA AND NEPAL

1. Concentrate efforts on areas in which reasonably viable wild populations (100 rhinos) in the wild can be developed and maintained: Kaziranga, Manas, Orang, Pobitora, Jaldapara, Dudhwa in India; Chitwan and Bardia in Nepal.

Such efforts should include habitat improvement, area extension, anti-poaching measures, and training of staff, public education campaigns, research and eco-development.

2. Calculate the financial resources currently available, and those additionally required for providing adequate protection for these populations. Develop project proposals for

submission to donors for additional financial support.

3. Assess the value to the conservation of the species of the small remnant population of rhinos, e.g. Gorumara NP, North Bengal through better information on current status and cost-benefit analysis of increased protection and management in such areas.
4. Continue efforts to establish other wild populations, elsewhere in India and Nepal, through translocations. But such translocations should be limited to sanctuaries where the carrying capacity exceeds 100 rhinos. It is recommended that there be follow-up surveillance to measure the success of the translocations.



Pic: Ashish Chandola

The Indian Rhino, like the other four species of Rhinos, is under constant threat of poachers

5. Expand the captive population mainly through propagation of rhinos already in zoos by transfer of animals, where required, from western zoos.
6. Encourage wildlife officials and their governments in India and Nepal to participate more fully in the activities of the IUCN/SSC Asian Rhino Specialist Group (AsRSG).
7. Continue measures to prevent illegal trade in rhino products from leaving India and Nepal for markets abroad.

The Norms of the IUCN'S Species Survival Commission (SSC) and Rhino Re-Introduction Specialist Group (RSG) and the Asian Rhino Specialist Group (AsRSG), on Re-Introduction of Rhinoceros into its former range of distribution are as follows:

The re-introduction of a species in its former range of distribution, with all factors in favor, is an accepted practice in the wildlife management, especially relevant in context to species like the rhino

which is habitat specific and has a restricted range of distribution at present.

According to IUCN Species Survival Commission and the Re-Introduction Specialist Group (SSC/RSG) defines "Re-Introduction as the international movement of an organism into a part of its native range from which it has disappeared or become extinct in historic times as a result of human activities".

Five criteria are to be followed before starting the rhino reintroduction programme

1. Reintroduction is the release of animals or plants of a species into an area in which it was indigenous, before extermination by human activities. Reintroductions are particularly useful where a species has become extinct due to human persecution, over-collection, over harvesting or habitat deterioration.
2. Reintroduction should only take place where the original causes of extinction have been removed or are in the process of being dealt with.



Pic: Ashish Chandola

National and international cooperation is required to eliminate the trade in rhinoceros 'horn'

3. Reintroduction should only take place where the habitat requirements of the species are satisfied. This means that that where species to be reintroduced becomes extinct in an area because of habitat change, or where significant deterioration has occurred in the habitat since the extinction, the species should not be reintroduced unless measures have been taken to reconstitute the habitat to a state suitable for the species.
4. The Basic Programme for Re-introduction Consists of:
 - i. A Feasibility Study
 - ii. A Preparation Phase
 - iii. Release Phase
 - iv. Follow-Up Phase: Study and Monitoring of Re-Introduced Animals on regular basis which includes,
 - (a) Study of the ecology of the species should reassess the relationship, the species had with the habitat into which reintroduction is to take place, and to assess the extent that the habitat has changed since the extinction of the species. The change in the species should also taken into account, they have been captive bred or cultivated, and allowance made for any change liable to affect the ability of the animal or plant, to re-adapt to its traditional Habit/habitat.
5. The animals or plant involved in the reintroduction must be of the available race or type closest to the original stock, and preferably be of the same race as that previously occurring in the area.



Pic: Ashish Chandola

There is an urgent need to re-introduce new rhino bloodline in the Dudwa National Park to improve the genetic diversity

Chapter X

THE FUTURE OF THE GREAT INDIAN ONE-HORNED RHINOCEROS

The future of the Great Indian One-horned Rhinoceros, as that of most of the wild animal species is not so secure in the current circumstances. So far in major habitats such as Kaziranga or Chitwan the animal has shown an upward trend, but is still under the shadow of poaching. Recently it has been reported by SOS Rhino, USA in their Newsletter (Feb, 2007), that in Bardia National Park, Nepal, the rhino population has drastically gone down to a mere 26 which was 83 some 4 years back. This may be due to internal unrest in Nepal which poachers found a golden opportunity to slaughter rhinos. But the Indian rhino is not, in a literal as well as figurative sense, out of the woods, yet. Their numbers are not large enough for it to have crossed the threshold towards safety. Civil unrest in the areas where it has survived, an unforeseen epidemic or two, might yet spur it towards total annihilation. If this unique species is not able to attain a population level that can be considered safe, where all threats of possible extinction are eliminated, a conservation strategy has to be framed practically (Dutta, 1991). The priorities of such a strategy should be:

1. Effective publicity against the use of the rhino horn by exposing the futility of such usage.
2. A determined effort, sustained over a number of years, for research on this animal.
3. Improvement in the existing infrastructure, strengthening protective and management measures, and the enactment of more stringent punitive laws against illegal trafficking in rhino horn.
4. Identification of other suitable areas with ideal rhino habitats as in the Buxa tiger Reserve, and setting these apart, exclusively for the rhino and other wildlife; translocation of the Indian rhinoceros to these places.
5. Full protection to, if possible, and extension of existing habitats to remove their island-like character.
6. As long as the demand for the rhino horn exists, the animals will not be safe, no matter what measures are adopted to protect them. A concerted publicity effort at an international level is required to educate people on the foolishness of using a commodity that does not have the properties ascribed to it. Legislation in countries like China and other Far-East countries forbidding the use of this ingredient in medicines will go a long way to curb the demand and give this species a fresh lease of life.



Pic: Ashish Chandola

Protection of charismatic species such as Indian Rhinoceros also protect other threatened species such as Otter (above) and the Swamp Deer (below)



Pic: Ashish Chandola

BIBLIOGRAPHY

- AKBAR (1590, 1949). 'Ain-I-Akbar of Abdul Fazal-I-Allami, vol.2. A gazetteer and administrative manual of Akbar's empire and past history of India. Translated into English by Colonel H.S. Jarret, 2nd Edition corrected and further annotated by Sir Jadu-Nath Sarkar. Royal Asiatic Society of Bengal, Calcutta. ix + 420 pp.
- ALBERUNI (1910). Alberuni's India: an account of the religion, philosophy, literature, geography, chronology, astronomy, customs, laws and astrology of India about AD 1030. English edition, with notes and indices, by Edward.C. Sachau, vol.1. Kengan Paul, Trench, Trubner & Co., London, i+408 pp.
- ALI, S.A. (1927). The Moghul emperors of India as naturalist and sportsmen, part I. *J. Bombay Nat. Hist. Soc.* 31 (4): 833-861.
- ALI, S., MATHUR, P.K., MALIK, P.K., CHOWDHARY, S.P AND ANSARI, S. (1997). Genomic DNA sequence variation in Rhinoceros unicornis and conservation implication. World Bank aided forestry project on study on the management of rhinoceros in West Bengal. *Wildlife Institute Report*. 1977. 200 pp.
- AITKEN, B. (1988). A Dudhwa diary. *Cub Vol.5* (4):18-22.
- ANONYMOUS (1878). List of animals in the Zoological Gardens, Calcutta. (Alipur Zoological Garden), Calcutta.
- ANONYMOUS (1887). Catalogue of the Mammalia in the collection of the Bombay Natural History Society. *J. Bombay Nat. Hist. Soc.* 1: 8-14.
- ANONYMOUS (1908). Maharaja of Coochbehar, 37 years of Big game shooting in Nripendra Bhup in Coochbehar. *The Duars and Assam*, Times Press, Bombay.
- ANONYMOUS (1934-74). Annual reports on game preservation (Wildlife Preservation) in Bengal. Govt of West Bengal, Directorate of forests for the year from 1935-1974.
- ANONYMOUS (1981). Management Plan of Gorumara Wildlife Sanctuary. Govt of West Bengal, for the period 1981-82 to 85-86.
- ANONYMOUS (1981). Management Plan of Jaldapara Wildlife Sanctuary, 1981-82 to 1985-86. Directorate of Forests, Government of West Bengal.
- ANONYMOUS (1982). Report of the committee to study the problems of man eating tigers in Kheri district of Uttar Pradesh. Ministry of Agriculture and Irrigation. Govt of India. New Delhi.
- ANONYMOUS (1981). Final recommendations on the translocation of Great Indian One Horned Rhinoceros, by the rhino sub committee. Wildlife status evaluation of IBWL. Govt of India. New Delhi.
- ANONYMOUS (1991). Some observations on habitat of the Dudhwa National Park. 1-7
- ANONYMOUS (1996). Records in the office of the divisional forest officer, Jalpaiguri division, Jalpaiguri, West Bengal.
- ANONYMOUS (1996). Records in the office of the Conservator of Forests (Hill Circle), Darjeeling, West Bengal.
- ANONYMOUS (1996). Records in the office of the Divisional Forest Officer. Natural History Museum, Darjeeling, West Bengal.
- ARA, J. (1954). Conservation problems in Bihar. *Journal of the Bengal Nat. Hist. Soc.* 27(2):66-73.
- ARCHER. M. (1980). Early views of India: the picturesque journeys of Thomas and William Daniell 1786-1794. Thames and Hudson, London. 240 pp.
- BABUR (1922). Babur-Nama (Memoirs of Babur), translated from the original Turki text of Zahiru'd-din Muhamed Babur Padshah Ghazi, by A.S. Beveridge. Luzac & Co., London (Reprint of 1970, Oriental Books Reprint, Delhi), xi+ 880+ xxxi pp.
- BAKHSI, N. (1995). Checklist of Birds of Dudhwa National Park. Unpublished. WII Lib.

- BAKER, E.B. (1887). Sports in Bengal, and how, when and where to seek it. Ledger, Smith & Co., London. xi+ 368 pp.
- BAKER, W.E and DURAND, H.M. (1836). Sub-Himalayan fossil remains of the Dadapur collection. *J. Asiat. Soc. Bengal* 5: 486-504.
- BALDWIN, J.H. (1877). The large and small game of Bengal and the Northwestern provinces of India. Kegan Paul, Trench & Co., London. xxiv + 380 pp.
- BANERJI, A. (1966). Rhinoceros-A historical Treatment, West Bengal Forests (Centenary Commemoration, Volume-1964). Forest Directorate, Government of West Bengal.
- BANERJEE, S AND CHAKRAVOORTY, S. (1973). Remains of the Great One-horned Rhinoceros, *Rhinoceros unicornis* Linnaeus from Rajasthan. *Sci and Cult.* 39(10): 430-431.
- Bauer, J.J. (1988). A preliminary assessment of the re-introduction success of the Asian One-horned Rhinoceros (*Rhinoceros unicornis*) in Bardia Wildlife Reserve. *Tiger Paper*, Oct-Dec: 26-32.
- BONAL, B.S. (1999). Action plan for Kaziranga National Park. Proceedings of IUCN / SSC Asian Rhino specialist Group meeting for India and Nepal, Meeting held in Kaziranga NP, Assam. Feb. 21-27, 1999.
- BERKMULLER, K., AND MUKHERJEE, S. (1987). Buffer zones in the service of eco-development. Symposium on tropical Ecology. December 1987: 1-18.
- BIN KHAN, M.K. (1989). Asian Rhinos: An Action Plan for Their Conservation. Gland, Switzerland: International Union for Conservation of Nature.
- BIST, S.S. (1994). Population history of Great Indian Rhino in North Bengal. *Zoo Print.* IX (3&4): 42-51.
- BLANFORD, W.T. (1891). The fauna of British India, including Ceylon and Burma: Mammalia. Taylor & Francis, London. v+xx+xiii+ 617 pp.
- BLYTH, E. (1862). The memoir on the living Asiatic species of Rhinoceros. *J. Asiat. Soc. of Bengal* 31(2): 151-175, pls 1-4.
- BOWREY, T. (1905). A geographical account of countries round the Bay of Bengal 1669 to 1679, edited by Richard Carnac Temple. Hakluyt Society (Works, Second Series, vol. 12), London. vi+ 387+37 pp.
- BRAHMACHARY, R.L., MALIK, B AND RAKSHIT, B. (1969). An attempt to determine the food habits of the Indian rhinoceros. *J. Bombay Nat. Hist. Soc.* 67(3): 558-60. 1971.
- CHAMPION, H.G. AND SETH, S.K. (1968): A revised survey of the forests type in India. Government of India Publications, New Delhi.
- CHATURVEDI, A.N., AND MISHRA, C.M. (1985). Ecological survey of grasslands at Dudhwa National Park. *Indian Foresters* 1-II (8): 579-582.
- CLARK, T.H. (1986). The Rhinoceros from Darer to Stubbs 1555-1799, Sotheby's Publication, London, 219 pp.
- COCKBURN, J. (1883). On the recent existence of *Rhinoceros indicus* in the North Western province; and a description of a tracing of an archaic rock painting from Mirzapore representing the hunting of this animal. *J. Asiat. Soc. Bengal* 52: 56-64, pls 7-8.
- COCKBURN, J. (1884). On the recent extinction of a species of rhinoceros in the Rajmahal Hills, and *Bos gaurus* in the Mirzapur District. *Proceedings of the Asiatic Society of Bengal*, September 1884: 140-141.
- COE, M. (1979). A look at wildlife management in India. *Oryx* 15(1): 60-65.
- CHOUDHURY, A. (1985). Distribution of Indian One-horned Rhinoceros (*Rhinoceros unicornis*). *Tiger paper* 12(2): 25-30.
- CORYAT, T. (1616). Traveler for the English Wits, London. (Reprinted and edited by William Foster, 1921. Early travels in India 1583-1619, pp. 234-287. Humphrey Milford, Oxford University Press, London xiv+ 351 pp.
- DANIELL, W. AND H. CAUNTER (1835). The oriental annual, or scenes in India; comparing twenty-two original engravings from original drawings by William Daniell, R.A. and a descriptive account, vol.2. Bull and Churton, London, vi+263 pp.

- DINERSTEIN, E. (1975). Vegetation of the Rapti River flood plain, Royal Chitwan National Park, Nepal. *Nepal Journal of Forestry* 4:16-23.
- DINERSTEIN, E. (1979). An ecological survey of the Royal Bardia Wildlife Reserve, Nepal. Part I: Vegetation, modifying factors, and successional relationship. *Biological Conservation* 15: 127-50.
- DINERSTEIN, E. (1980). An ecological survey of the Royal Karnali- Bardia Wildlife Reserve, Nepal. Part-III: Ungulate populations. *Biological Conservation* 18: 5-38.
- DINERSTEIN, E. (1985). Just how many rhinos are there in Chitwan? Smithsonian Nepal Terai Ecology Project Newsletter 2:5.
- DINERSTEIN, E. (1987). Deer, plant phenology, and succession in the lowland forests of Nepal. In C. Wemmer, Ed., *Biology and Conservation of the Cervidae*, pp. 272-88. Washington, DC: Smithsonian Institution Press.
- DINERSTEIN, E. (1989). The foliage-as-fruit hypothesis and feeding ecology of south Asian ungulates. *Biotropica* 21: 214-18.
- DINERSTEIN, E., S.R. SHRESTHA, AND H. MISHRA. (1988). Adoption in Greater One-Horned Rhinoceros *Rhinoceros unicornis*. *Journal of Mammalogy* 69: 813-14.
- DINERSTEIN, E., S.R. SHRESTHA, AND H. MISHRA. (1990). Capture, chemical immobilization, and radio-collar life for greater one-horned rhinoceros. *Wildlife Society Bulletin* 18: 36-41.
- DINERSTEIN, E AND PRICE, L. (1991). Demography and habitat use by greater one-horned rhinoceros in Nepal. *J. Wild. Manage.* 55: 401-411.
- DINERSTEIN, E. (1991a). Sexual dimorphism in greater one-horned rhinoceros (*Rhinoceros unicornis*). *Journal of Mammalogy* 72: 450-57.
- DINERSTEIN, E. (1991b). Seed dispersal by Greater One-Horned rhinoceros (*Rhinoceros unicornis*) and flora of Rhinoceros latrines. *Mammalia* 55: 355-62.
- DINERSTEIN, E. (1992). Effect of *Rhinoceros unicornis* on riverine forest structure in lowland Nepal. *Ecology* 73: 701-04.
- DINERSTEIN, E., AND K. BARGONA (2000). Saving cells is no way to save a species. *Washington Post*, May 28, p. 83.
- DINERSTEIN, E., AND G.F. MCCracken (1990). Endangered greater one-horned rhinoceros carry high levels of genetic variation. *Conservation Biology* 4: 417-22.
- DINERSTEIN, E., AND J.N. MEHTA (1989). The clouded leopard in Nepal. *Oryx* 29:199-201.
- DINERSTEIN, E., AND C. WEMMER (1988). Fruit Rhinoceros eat: Dispersal of *Trewia nudiflora* (Euphorbiaceae) in lowland Nepal. *Ecology* 68: 1768-74.
- DINERSTEIN, E., AND E.D. WIKRAMANAYAKE (1993). Beyond hot spots: How to prioritize investment in biodiversity conservation in the Indo-Pacific region. *Conservation Biology* 7: 53-65.
- DINERSTEIN, E., et al. (1997). A Framework for High Priority Areas and Actions for the Conservation of Tigers in the Wild. Washington DC: World Wildlife Fund-United States, Wildlife Conservation Society, and National Fish and Wildlife Foundation.
- DINERSTEIN, E (2003). The Return of the *Unicorns*: The Natural History and Conservation of the Greater One-Horned Rhinoceros. Pages 316, Publisher Columbia Univ Press, USA.
- DEY, S.C. (1999). Over view of Indian Rhino Action Plan. Proceedings of IUCN / SSC Asian Rhino specialist Group meeting for India and Nepal. Meeting held in Kaziranga NP, Assam. Feb. 21-27, 1999.
- DEY, R. (2000). Management Plan of Dudhwa National Park for the period 2000-01 to 2010-11. Department of Forests, Uttar Pradesh.
- DOLEY, S. (1999). A report on Rhino situation and action plan in Assam. Proceedings of IUCN / SSC Asian Rhino specialist Group meeting for India and Nepal, Meeting held in Kaziranga NP, Assam. Feb. 21-27, 1999.

- DUTTA, A.K. (1991). *Unicornis: The Great Indian One-Horned Rhinoceros*. Konark Publishers Pvt. Ltd., New Delhi.
- ETTINGHAUSEN, R. (1950). Studies in Muslim iconography, I: the unicorn. *Occ. Papers Freer Gallery of Art* 1(3): 1-209.
- FALCONER, H AND CAUTELY, P.T. (1847). *Fauna Antiqua Sivalensis, being the Fossil Zoology of the Siwalik Hills in the North of India. Illustrations, Part III: Suidae and Rhinocerotidae. Plates 69-80*. Smith, Elder and Co., London.
- FALCONER, H. (1868). *Palaeontological memoirs and notes*, 2 vols. Robert Hardwickwicke, London.
- FAWCUS, L.R. (1943). Report of the game fish preservation committee on the existing species of game in Bengal. 15-19 page report. Government of West Bengal.
- FRANK'S (1886). Letters on sport in eastern Bengal. R.H. Porter, London. xix, 255 pp.
- FOOSE, T.J., AND N.VAN STRIEN. Eds. (1997). *Asian Rhinos-Status Survey and Conservation Action Plan*. Cambridge: Union for Conservation of Nature and Natural Resources.
- FOOTE, F.B. (1874). *Rhinoceros deccanensis*, a new species discovered near Gokaka, Belgaum District. *Mem. Geol. Sur. India (Palaeont, India). Series X*, 1(1): 1-17.
- GEE, E.P. (1952). The Great Indian One-horned Rhinoceros. *J. Bengal. Nat. Hist. Soc.* XXV (4): 173-177.
- GEE, E.P. (1959). Report on survey of the rhinoceros area in Nepal. *Oryx* 5: 59-85.
- GHIMIRE, P.K. (1997). Digital data base of Royal Bardia National Park.
- GHOSH, D.K. (1993). Studies on the eco-status of the Indian rhinoceros *Rhinoceros unicornis* with special reference to altered habitat due to human interference in Jaldapara Sanctuary, West Bengal. Ph.D. Dissertation, Ranchi University, Bihar.
- GIBB, H.A.R. (1971). The travels of Ibn Batuta AD. 1325-1354, translated with revisions and notes from Arabic text edited by C. Defrenery and B.R. Sanguinetti, vol.3. Hakllyat Society (Works, Second series, no.141), Cambridge, xii+539-772 pp.
- GREW, N. (1681). *Museum Regalis Societatis or a catalogue & description of the natural and artificial rarities belonging to the Royal Society and preserved at Gresham College*. W. Rawlins, London, xii+ 388 pp.
- GUPTA, A.C. (1958). Gorumara Game Sanctuary. *J. Bengal Nat. Hist. Soc.* XXIV (4):133-139.
- HAJRA, P.K., AND SHUKLA, U. (1982). Dudhwa National Park. Botanical Survey of India. (Some botanical aspects of the proposed new habitat for rhino). Howrah. April 1982: 1-12 (1): 41-48.
- HEBBEERE, E.O AND RAY, S. (1950). The Great One-horned Rhinoceros (*Rhinoceros unicornis*). *Jour. Bengal Natural History Society*. XXII: 88-91.
- HEWETT, J.P. (1938). *Jungle trails in northern India, reminiscences of hunting in India*. Methuen, London, 278 pp.
- HOLLOWAY, C. (1973). Swamp deer in Uttar Pradesh. *Oryx* 12 (1): 41-48
- Hussein. B. (2001). Status of *Rhinoceros unicornis* in Orang National Park, Assam. *Tiger paper* 28(1): 25-27.
- IUCN (1990). IUCN Red list of threatened animals. IUCN, Gland, Switzerland and Cambridge, UK.
- JAHANGIR (1914). The Tuzuk-Jahangiri, or Memoirs of Jahangir, translated by Alexander Roger, edited by Henry Beveridge, vol.2. London (Reprint of 1968, Munshiram Manoharlal, Delhi), vii+315 pp.
- JERDON, T.C. (1874). The mammals of India. John Wheldon, London, xxi+319+xv pp.
- JAIN, S.K., AND SASTRY, A.R.K. (1983). Botany of some tiger habitats in India. Botanical Survey of India. 70 pp.

- JARRET, H.S. (1949). *Ain-I-Akbari* of Abdul Fazl-I-Allami, II: A Gazetteer and Administrative Manual of Akbar's Empire and Past History of India. 2nd ed., corrected and further annotated by Sir Jadu-Nath.
- JOSHI, A. (1986). The role of greater one-horned rhinoceros in the dispersal and ecology of the weed *Cassia tora* in Chitwan Valley. M.Sc. Thesis. Tribhuban University, Kathmandu, Nepal.
- JNAWALI, S.R. and Wegge, P. (1993). Space and habitat use by a small reintroduced population of Greater One-Horned Rhinoceros (*Rhinoceros unicornis*) in Royal Chitwan National Park in Nepal - A preliminary Report. PP 208-217. Proc of an International Conference, Zoo. Soc, Sand Diego, USA.
- KHAN, M.K. AND FOOSE, J. (1994). A Report: Asian Rhino Specialist Group. *Pachyderm* 18:3-8.
- KUMAR, A. (1996). Forest type mapping of Dudhwa National Park using remote sensing and GIS. P. G. Diploma in Forest Ecology. IIRS, Dehra Dun.
- KUMAR, VIMAL AND SINHA, S.P. (2002). An evaluation of the measures of success and problems in establishing and managing the re-introduced population of rhinoceros in Dudhwa Tiger Reserve. XXIII PG. Diploma Course in Wildlife Management Wildlife Institute of India.
- LEHMKUHL J.F. (1989). The ecology of a south Asian tall grass community. Ph. D. Dissertation, University of Washington, USA. 195 pp.
- LEITH, H. (1975). Primary production of major vegetation units of the world. 203-215. In: Leith.H & R.H. Whittaker. Eds. Primary productivity of the Biosphere. Springer-Verlag, New York. Lutton-Brock, (1965).
- LYDEKKAR, R. (1876). Descriptions of the molar teeth and other remains of mammalian. *Mem. Geol. Surv. India (Palaeont. India)*, series X, 1(2): 19-87.
- LYDEKKAR, R. (1880). A sketch of the history of the fossil vertebrata of India. *J. Asiat. Soc. Bengal* 49: 8-40.
- MANNERS-SMITH (1909). Haunts of the Indian Rhinoceros. *J. Bombay Nat. Hist. Soc.* 19(3): 746-747.
- MASKEY, T. (1999). Strategies of rhino conservation in Nepal. Department of National Parks and Wildlife conservation HMG, Nepal. Proceedings of IUCN / SSC Asian Rhino specialist Group meeting for India and Nepal, Meeting held in Kaziranga NP, Assam. Feb. 21-27, 1999.
- MASKEY, T.M., JNAWALI, S.R., PRADHAN, N.M.B AND DHAKAL, N.P. (2001). Reintroduction of Greater One-Horned Rhinoceros (*Rhinoceros unicornis*) in the Royal Bardia NP and Royal Sukhlaphanta WR, Western Lowland, Nepal. Proceedings of the International Elephant and Rhino Research Symposium, Vienna, June 7-11, 2001. pp. 202-209.
- MARTIN, C. (1975). Status and Ecology of the Barasingha (*Cervus duvauceli branderi*) in Kanha National Park (India). *Organ. Kolb. Zwich*, 134 pp.
- MARTIN, E.B. AND C. MARTIN (1980). *Run Rhino Run*. Chatto & Windus, London, 136 p.
- MARTIN, E.B. (1992). The poisoning of rhinos and tigers in Nepal. *Oryx* 26(2): 82-86.
- MARTIN, E AND VIGNE, L. (1996). Numbers of Greater one-homed rhino continue to rise. News and views. *Oryx* 30(3).
- MARSHALL, J. (1931). *Mohenjo-Daro and the Indus civilizations*, 3 vols. Arthur Probsthain, London.
- MENON, V. (1996). Under Siege: Poaching and protection of Greater One-horned Rhinoceros in India. Traffic India, WWF-India, New Delhi. p. 114.
- MENON, V., ASHRAF, N.V.K., P. PANDA AND K. MANIKAR. (2005). *Back to the Wild*. Wildlife Trust of India. 302 pp.
- MISHRA, H.R AND DINERSTEIN, E. (1987). New zip codes for resident rhinos in Nepal. *Smithsonian Magazine* 18: 67-73.
- MISHRA, G.C. (1989) Rhino rehabilitation in Dudhwa National Park. *Van Vigyan* Vol. 27(1): 60- 64.
- Mishra, C.M., and Chaturvedi, A.N. (1985). Ecological survey of grasslands at Dudhwa National Park. *Indian Forester* Vol. 111(8): 579-582.

- MOMIN, K.N., SHAH, D.R. AND OZA, G.N. (1973). Great Indian Rhinoceros inhabited Gujarat. *Current Science* 42: 801-802.
- MUKHERJI, A.J. (1963). The extinct, rare and threatened game of the Himalayas and the Siwalik ranges. *J. Bengal Nat. Hist. Soc.* 32(1): 36-37, pp. 1-8.
- NATH, B. (1976). On the occurrence of Great Indian rhinoceros *Rhinoceros unicornis* Linn. From the prehistoric site at Chirand, Saran district, Bihar. News letter, Zoological Survey of India 2(3): 86-87.
- PANDIT, P.K AND YADAV, V.K. (1996). Management Plan of Jaldapara Wildlife Sanctuary, West Bengal, India. *Tiger Paper* 23(4):1-5.
- PARKS, F. (1850). The wanderings of a pilgrim in search of the picturesque during four-and-twenty years in the east, with revelations of life in the zenana. Pelham Richardson, London.
- PELINCK, E AND UPRETI, B.N. (1972). A census of rhinoceros in Chitwan National Park and Tamaspur forest, Nepal. HMG/FAO/UNDP. National Park and Wildlife Conservation Project. A report, Kathmandu. 10 pp.
- PENNANT, T. (1798). The view of Hindoostan, vol. 2: Eastern Hindoostan, Henry Hughs, London.
- PRASHAD, B. (1936). Animal remains from Harappa. *Mem. Archaeological Survey of India* 51: 1-76.
- PRATER, S.H. (1948). The book of Indian Animals. Bombay Natural History Society, Oxford University Press, Calcutta, Delhi, Chennai, Mumbai.
- QURESHI, Q., AND SAWARKAR, V.B. (1991). Protected area design and conservation: Dudhwa National park. A case study. National Symposium of Environment and wildlife. Indian Soc. of Environment.
- QURESHI, Q., SAWARKAR, V.B. AND MATHUR, P.K. (1990). Status and management of swamp deer in Dudhwa National Park. Seminar on management of Swamp deer in Dudhwa Tiger Reserve. INTACH and WWF-India.
- QURESHI, Q., SAWARKAR, V.B. AND MATHUR, P.K. (1990). Ecology and management of Swamp deer *Cervus devaueceli devaueceli* in Dudhwa Tiger Reserve. Project report of Wildlife Institute of India.
- QURESHI, Q., SAWARKAR, V.B AND MATHUR, P.K. (1989). Dudhwa National Park - The ark must be kept afloat. Unpublished Paper.
- RAO, V.S. (1959). Inspection notes of Conservator of Forests. Northern Circle, West Bengal, November 1953 to February, 1956. West Bengal Press, Alipur.
- RAJ, T. AND SINHA, N.K. (1988). Some of the problems of management of Dudhwa National Park. *Cheetal* 28(3): 41-44.
- RAHA, A.K. (1996). Management Plan of Jaldapara Wildlife Sanctuary, West Bengal. Period 1996-97 to 2006-07. Vol 1-3, West Bengal Forest Department.
- RAHA, A.K. (1996). Wildlife Conservation in West Bengal: A decade at a glance. Wildlife Wing; Forest Department, Govt. of West Bengal. 58 pp.
- RAHA, A.K (1999). Status Report on Rhino Conservation and Action Plan for West Bengal. Proceedings of IUCN / SSC Asian Rhino specialist Group meeting for India and Nepal, Meeting held in Kaziranga NP, Assam. Feb. 21-27, 1999.
- RAHMANI, A. (1996). Present status of the Bengal Florican *Houbaropsis bengalensis* in Dudhwa Tiger Reserve. A Report. BNHS Publication, Bombay.
- Rizvi, S.H.A. (1979). Working plan for the South Kheri Forest Division. Vol 1 (Part 1 & 2), Uttar Pradesh Forest Department.
- Rizvi, S.H.A. 1979. Working plan for the South Kheri Forest Division. Vol 2.
- RAO, H.S (1957). History of our knowledge of the Indian fauna through the ages. *J. Bombay. Nat. Hist. Soc.* 54:251-280.
- ROOKMAAKER, L.C. (1980). The distribution of the rhinoceros in eastern India, Bangladesh, China, and the Indo-Chinese region. *Zoologische Anzeiger* 205(3/4): 253-268, Figs.1-2.
- ROOKMAAKER, L.C. (1984). The former distribution of the Indian Rhinoceros (*Rhinoceros unicornis*) in India and Pakistan. *J. Bombay Nat. Hist. Soc.* 80: 555-563.

- ROOKMAAKER, L.C. (1999a). William Daniell's depictions of the rhinoceros in India. *Archives of Natural History* 26(2): 205-210, figs. 1-3.
- ROOKMAAKER, L.C. (1999b). The Rhinoceros of Kotdwara. Hornbill. July- September: 9, 1 fig.
- ROOKMAAKER, L.C. (1999c). Records of the rhinoceros in Northern India. *Saugetierkundliche* 44(2):51-78, figs. 1-6.
- ROOKMAAKER, L.C. (2000). Records of the rhinoceros in Pakistan and Afghanistan. *Pakistan Jour. of Zool.* 32(1): 65-74, figs.1-3.
- ROOKMAAKER, L.C. (2002). Historical records of the Rhinoceros (*Rhinoceros unicornis*) in northern India and Pakistan. *Zoo Print* 17 (11): 923-929.
- RODGER, W.A. (1988). The wild grazing ungulates of India: An ecological review. Proceedings of the second International Rangeland Congress, New Delhi.
- SALE, J.B., AND M.H. WOODFORD. (1981). Preliminary report on drug immobilization and transport of the Indian Great Rhinoceros. FAO, Rome, 1981.
- SALE, J.B. AND SINGH, S. (1987). Reintroduction of Greater Indian rhinoceros into Dudhwa National Park. *Oryx* Vol. 21(2): 81-84
- SALE, J.B. (1986). Rhinos re-established in Uttar Pradesh. *Indian Forester* 112 (10): 945-48.
- SALE, J.B. (1986). Reintroduction in Indian wildlife management. *Indian Forester* 112(10):867-73.
- SANKARAN, R. (1988). The Bengal Florican at Dudhwa National Park. The Floricans. Bombay Natural History Society. Annual Report No. 4: 25-32.
- SANKARAN, R. (1988). Studies of the Swamp deer in Dudhwa National Park (1988-1989). Endangered species project. Bombay Natural History Society. Technical Report No.14.
- SANKARAN, R. (1989). Status of the swamp deer in Dudhwa National Park 1988-1989. Bombay Natural History Society. Technical Report No. 14:25.
- SANKARAN, R. (1990). The Bengal Florican in Dudhwa National Park. In: Status and Ecology of Lesser Bengal Florican with report on Jerdon Courser and Mountain Quail. Bombay Natural History Society. 45-54.
- SARKAR. S.R. (1951). Royal Asiatic Society of Bengal (*Bibliotheca Indica*, 271). Calcutta.
- SATYA PRAKASH AND SINHA, S.P. (2002). Examine the possibilities of enlarging/managing larger habitat for the re-introduced rhino with planning details in Dudhwa Tiger Reserve. XXIII PG Diploma Course in Wildlife Management. Wildlife Institute of India, Dehra Dun.
- SAWARKAR, V.B. (1988). Status of the northern Swamp deer *Cervus duvauceli duvauceli* in the Dudhwa National Park. A report Wildlife Institute of India.
- SAWARKAR, V.B. AND SINHA, S.P. (1997). Study on the Management of Rhinoceros in Jaldapara WLS and Gorumara NP, North Bengal West Bengal Aided Forestry Project, Nov. 1997 pp. 201 (Rhino Section).
- SCHAAF, D. AND SINGH, A. (1977). Barasingha in the Dudhwa sanctuary. *Oryx* Vol. 13(5): 495-498.
- SCHALLER, G.B. (1967). The deer and the Tiger. Chicago Urn Press, Chicago. 370 pp.
- SCHENKEL, S. (1981). Report on the suitability of Dudhwa National Park as potential site for reintroduction of the Indian rhinoceros. 21-24.
- SINGH, A. (1978). The status of the Swamp deer (*Cervus duvauceli duvauceli*) in the Dudhwa National Park. In: Peter Scott Chairman, Threatened Deer. International Union Conservation of Nature & Natural Resource (IUCN), Morges, Switzerland.: 132-142.
- SINGH, A.N. AND SINGH, A. (1985). A checklist of birds of Dudhwa National Park. A report by the UP Forest Department, Lucknow.
- SINGH, L. (1991). Present status of Barasingha *Cervus duvauceli duvauceli* in India and its conservation. Paper presented at the International Seminar on Veterinary medicine in wild and captive animals. 8-10 November 1991. Bangalore.
- SINGH, R.L. (1994). Dudhwa Rashtriya Udhyan. In: Van

- Vanyajeev aur Vanvasi. Pub: Bishen Singh Mahendra Pal Singh, Dehra Dun.
- SINGH, R.L. (1983). Management Plan of Dudhwa National Park. Uttar Pradesh Forest Department (unpunished).
- SINGH, R.L. (1986). Conflict in the Wild. India Today.
- SINGH, V.B. (1978). The elephants in UP - a resurvey of its status after 10 years. *J. Bombay Nat. Hist. Soc.* Vol. 75(1): 71-82.
- SINGH, V.P. (1982). Bio-ecological studies on *Cervus duvauceli duvauceli*, Swamp deer (Barasingha) in Dudhwa near Indo-Nepal border. Ph.D. thesis, Kanpur University (unpublished) Singh, V.P. 1987. Dudhwa National Park. Animal Citizen Vol. 26(1):46.
- SINHA, S.P. AND SAWARKAR, V.B. (1991). Management of the reintroduced Indian One-horned Rhinoceros in Dudhwa National Park - A Report of Wildlife Institute of India. Dehra Dun.
- SINHA, S.P. AND SAWARKAR, V.B. (1991). Management of the reintroduced Great one-homed rhinoceros (*Rhinoceros unicornis*) in Dudhwa National Park, UP, India. International Rhino Conference, Rhinoceros Biology and Conservation, San Diego, California, USA. 9-11 May, 1991.
- SINHA, S.P. AND SAWARKAR, V.B. (1991). Habitat and dietary selection by the population of reintroduced Great Indian One-homed rhinoceros *Rhinoceros unicornis* in Dudhwa National Park. International Rhino Conference, Rhinoceros Biology and Conservation, San Diego, California, USA. 9-11 May 1991.
- SINHA, S.P. (1991). Rhino reintroduction programme in Dudhwa National Park, an update. IUCN Reintroduction Specialist Group Newsletter No. (2). Nov 1991.
- SINHA, S.P. (1991). Hispid Hare *Caprolagus hispid* rediscovered in Dudhwa National Park. *Zoo Print* 4(4), Nov 21.
- SINHA, S.P. AND SAWARKAR, V. B. (1992). Management of the reintroduced Indian Great One-Homed Rhinoceros (*Rhinoceros unicornis*) in Dudhwa National Park. IV World Congress of National Parks and protected areas, Caracas, Venezuela. 10-21 February 1992.
- SINHA, S.P. (1992): Establishing identities of individual Rhino (*Rhinoceros unicornis*) based on characteristics features: WII Newsletter, January-March, 1992, Vol. 7 No. 1.
- SINHA, S.P. AND SAWARKAR, V.B. (1994). Ten years of the Asian Rhino reintroduction programme in Dudhwa national Park, India. IUCN reintroduction Specialist Group Newsletter. No. 9.
- SINHA, S.P., SAWARKAR, V.B. AND MUKHERJEE, S.K. (1995). Bibliography of Indian One-homed Rhinoceros (*Rhinoceros unicornis*). Wildlife Institute of India, Dehra Dun.
- SINHA, S.P. AND SAWARKAR, V.B. (1996). Monitoring and Management of reintroduced rhinoceros in Dudhwa National Park. International Conference on Sustainable Use of Natural resources, Budapest, Hungary. 26-29 August 1996.
- SINHA, S.P. AND SINGH, A.K. (1999). Establishing a Viable rhino population and restoration of corridor habitat in Western Terai RCU- A preliminary Survey Report submitted to WWF-India, New Delhi.
- SINHA, S.P., SAWARKAR, V.B. AND TIWARI, A. (2001). Management of Re-Introduced Greater One-horned Rhinoceros (*Rhinoceros unicornis*) in Dudhwa National Park and Tiger Reserve, Uttar Pradesh, India. Paper presented in International Conference on Elephant and Rhino Conservation, Vienna, Austria, 2001.
- SINHA, S.P. (2002). Rhino Reintroduction Programme in Uttaranchal State. Proposal Submitted to Minister of Forest, Uttaranchal State and approved. Updated in 2004.
- SINHA, S.P. (2003). Assessment and restoration of corridor between Dudhwa NP and Katarniaghat WLS. Project funded by US Fish & Wildlife Services, USA. 286 p.
- SINHA, S.P. (2003). Managing a small reintroduced rhino population in Dudhwa NP & Tiger Reserve. Paper presented in IUCN Reintroduction Group meeting

- held in Colombo, Sri Lanka from 7 to 12 December, 2003.
- SINHA, S.P. (2002). Creation of viable breeding satellite population of Greater Indian One-horned Rhinoceros (*Rhinoceros unicornis*) in Badhital sector of Dudhwa National Park. Uttar Pradesh. A SOS funded Rhino Project Updated to 2004-2007.
- SILLET, J.J (1996). The Jaldapara Wildlife Sanctuary, West Bengal. *J. Bombay Nat. Hist. Soc.* 63 (3): 534-556.
- SULEIMAN, H. (1970). Miniatures of Babur-Nama. Academy of Science of the Uzbek, SSR, Taschkent.
- SUMAN, D.N.S. (1994). Rhino reintroduction in Dudhwa. *Zoo Print* 9 (2): 74.
- TALUKDAR, B.K. (1999). Status of *Rhinoceros unicornis* in Pabitora Wildlife Sanctuary, Assam. Tiger paper. 26(1): 8-10.
- TAVERNIER, J. (1924). Travels in India. Translated from the original French edition by V. Ball. 2nd edition, (edited by W. Crooke), Vol. I. London (Reprint Co., Delhi), xci+ 335 pp.
- TILAK, R. AND RAY, P. (1990). Range extension and notes on *Rana erythrae* from Dudhwa National Park, Uttar Pradesh. *J. Bombay Nat. Hist. Soc.* 87(3): 380-384.
- VAMBERY, A. (1899). The travels and adventures of the Turkish Admiral Sidi Ali Reis in India, Afghanistan, Central Asia and Persia, during the years 1553-1556. Translated from the Turkish with notes. Luzac and Co., London.
- VIGNE, L AND MARTIN, E.B. (1994). The Greater One-Horned Rhino of Assam threatened by poachers. *Pachyderm*, 18:28-43.
- WILDLIFE INSTITUTE OF INDIA PROJECT REPORT, (1997). Study on the management of rhinoceros in West Bengal., West Bengal World Bank aided Project, Wildlife Institute of India, Dehra Dun. 201 pp.
- WILDLIFE INSTITUTE OF INDIA PROJECT REPORT (2002). Management of Forests for Biological Diversity and Productivity. WII-USDA Forest Service Project (1996-2002). Wildlife Institute of India, Report.
- WILLIAM, L.A., E.M. LANG AND C.P. GROVES (1983). *Rhinoceros unicornis*. *Mammalian species*. 211: 1-6, figs. 1-3.
- WILLIAMSON, T. (1807). Oriental field sports; being a complete, detailed and accurate description of the wild sports of the East. Edward Orme, London, iii+150 pp.
- WIRZ-HLAVACEK, G., S. ZSCHOKKE AND P. STUDER (Editors) (2001). International Studbook for the Greater One-horned Rhinoceros *Rhinoceros unicornis* Linne, 1758, 11th edition Basel Zoo, Basel, 54 pp.
- YULE, H. (1863). Mirabilia Descripta, the wonders of the east, by Friar Jordanus. Hakluyat Society (Works, vol. 31), London, iv+xvii+68 pp.
- YULE, H AND A.C. BURNELL (1903). Hobson-Jobson. John Murray, London, 1022 pp.
- ZUENER, F.E. (1952). The micro industry of Langhnaj, Gujarat. *Man* 52: 129-131.



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The Great Indian One-horned Rhinoceros (*Rhinoceros unicornis*) is listed as one of the world's most endangered species among the mega herbivores. Within the Indian subcontinent, it once ranged from the foothills of the Hindukush mountain range (Pakistan) to Myanmar, all along the flood plain of rivers Indus, Ganges and Brahmaputra.

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